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THE LOADING AND CARRIAGE OF SEA-BORNE COAL.

By F. Seaton Snowdon.

SEA-BORNE coal, as shown by the records, formed an item in the trade of London as far back as the year 1228. The coal referred to in these records was brought from Newcastle and landed at Jacobs Lane, in the "Fleet." This is the first evidence we have of the use of Northumbrian coal in the south of England.

In 1849, or three years before the first steam collier, the John Bowes, commenced to ply between the Tyne and the Thames, the total importation of sea-borne coal into London was 3,418,000 tons. This figure had increased to 7,288,000 tons in 1898, in which year the United Kingdom exported 36,562,796 tons of coal, coke, and patent fuel, valued at £18,135,502, the total output of the country during the year being 203,054,516 tons. How these totals had grown and still continue to grow may perhaps be better realised when it is stated that thirty years ago a Royal Commission reported that in the previous

A homely Spanish proverb reads that "In eating and scratching, everything is the beginning." So it is often in the larger feeding upon foreign supplies. Currents of export trade, once started, gather volume as they move and soon become settled channels. This is likely to prove true in the yet new export of American coals. Every sign points to the early transfer, to transoceanic business, of the attention and the appliances heretofore chiefly devoted to American lake traffic. The situation lends particular interest to this review of the situation by an impartial authority, especially when joined with a display of the results already attained in the United States in the movement of coal cargoes under conditions practically identical with those governing Transatlantic freight business.—THE EDITORS.

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year, 1869, the total quantity of coal raised in Great Britain was but 107,427,537 tons, of which 9,775,470 tons were exported and 3,277,562 tons were used for "purposes of steam navigation," in other words, as bunkering fuel. Coming now to the latest figures available, we find that the coal output for the United Kingdom in 1899 is given as 220,085,000 tons, and the exports, including bunkers and coke, at 55,335,369 tons. The total coal exported last year by Great Britain was 41,180,300 tons, valued at £23,105,691, a further 12,226,801 tons being supplied for the bunkers of steamers engaged in foreign trade.

NEW DOCK OFFICE AT CARDIFF, THE GREAT SHIPPING PORT FOR WELSH COALS.

According to the figures supplied by the United States Geological Survey, the output of coal in the States last year was 196,405,935 "long" tons. The British Board of Trade is a little more generous in the matter and credits American pits with an output last year of 218,376,000 tons. However that may be, there appears to be no reason to doubt the figures referring to the United States export of coal during last year, which are given at 5,752,150 long tons, valued at $15,713,376, or roughly, £3,145,000.

Combining these figures for 1899, we find that the two great coal-producing countries of the world (the English and American returns account for fully 60 per cent. of the whole world's output during 1899), sent afloat in the period indicated cargoes of coal representing in the aggregate no less than 46,932,450 tons in weight and £26,250,-

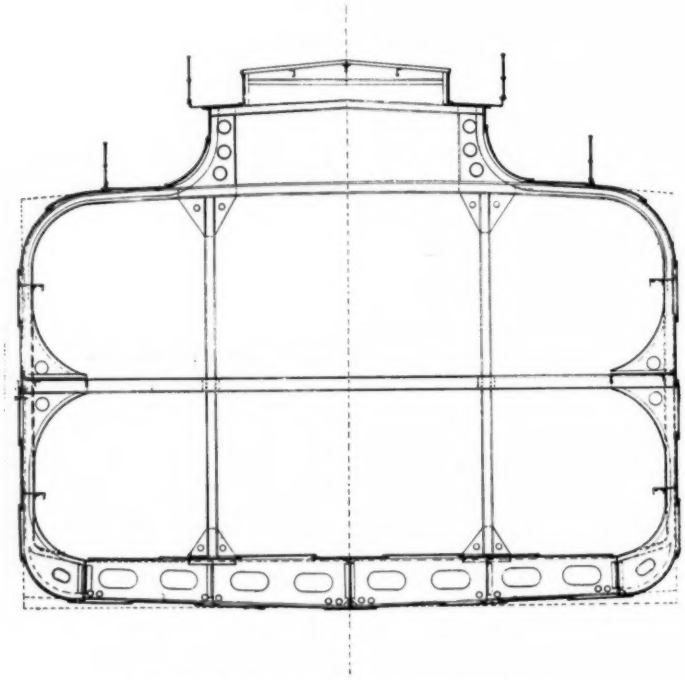
691 in value. If to this we add coke and patent fuel and the coal and coke exported by other countries, it will be well within bounds to say that over 1,200,000 tons of fuel were shipped every week of the past year.

The magnitude of this trade and the volume of shipping that it gives employment to can best be realised when we remember that even at this end of the nineteenth century there are but very few of our ocean colliers that lift over 7,000 tons of cargo. Luckily, however, the modern "self-trimmer" will take in coal much more rapidly than any general cargo can be shipped. As an instance, with the Lewis-Hunter patent coaling cranes, as used at Cardiff, not only has the speed of

BUTE COAL-LOADING DOCKS, WITH LEWIS-HUNTER CRANES, CARDIFF.
Twenty-two ships, aggregating 121,000 tons, were in the harbour when the view was taken.

loading coal been proved to be 293 tons with one crane in an hour, but the coal is shipped in very much better condition owing to the construction of the carrying boxes, or hoppers, each holding 10 tons, the cone valve or bottom of which is only released to let the coal out when it is within 18 inches of the flooring, an advantage easily appreciated when dealing with a friable coal. Vessels carrying as much as 10,000 tons have been loaded by these cranes, and 7,000 tons have been put on board of them in the 24 hours. In the case of the steamship Samoa 7,484 tons of cargo and 1,750 tons of bunkers were put on board at the

average rate of 330 tons an hour, and in the present state of the labour market it is perhaps of sufficient interest to note that this 6,000-ton self-trimmer was loaded under these cranes without having to send a single "shovel" below for trimming purposes, thus saving considerable time. The Cardiff "trimming" rate, it may be mentioned, is 2¾d. per ton for these ships, varies from 6d. to 1s. per ton for bunkers and difficult ships. There were eleven of these cranes at work in the Cardiff docks at the time of my visit. Another method for rapidly shipping coal is in use by the Cramlington Coal Company in the



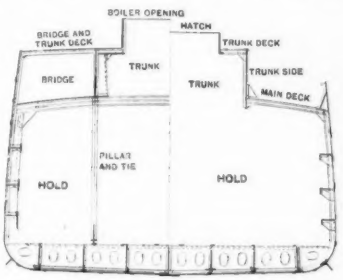
MIDSHIP SECTION OF A VESSEL OF THE TRUNK TYPE.

Northumberland Dock, on the Tyne. This is a belt-conveying system invented by Mr., now Sir, Thomas Wrightson.

With the advantages above stated in its favour, it need scarcely be said that the "self-trimmer," "trunk-deck," "turret-deck," or call them what you will, steamers (collectors of dues and other interested parties call them "cargo-cheaters") quickly came into favour with coal ship-

pers and each year they are being built in increasing numbers and size, and notably in the yards on the north-east coast.

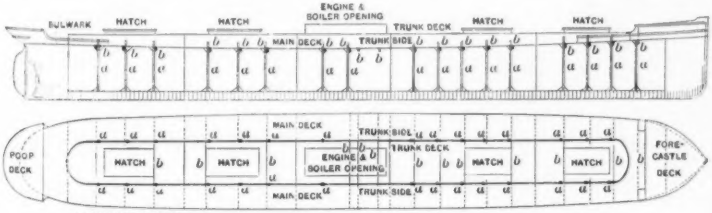
Before entering upon a description of the structural peculiarities of this type of ship, it may be noted that they are all good sea boats with increased stability. The self-trimmer, in addition to effecting a saving in trimming charges, also lends itself to a considerable reduction of net tonnage, hence the generic term "cargo-cheaters." These vessels are also well-adapted for carrying a large cargo on a small draft, and although they give clear hold spaces the shifting of the cargo is well-nigh impossible, a further point in their favour being that they are good timber carriers, both in hold and deck cargo. Regarded æsthetically, the self-trimmer certainly cannot be considered a thing of beauty, though as dividend earners they may prove a joy forever to their owners.



SECTION THROUGH A TRUNK-DECK STEAMER.

Briefly described, a self-trimmer may be said to be a vessel having erected on the midship portion of the upper deck two fore-and-aft vertical girders which extend for at least one-half of the vessel's length. These are sufficiently incorporated with the main structure of the vessel, as shown in the accompanying sectional drawings of the various types, and usually carry on the deck connecting the upper members of the girders all hatches, deck machinery, loading and discharging gear, pipes, ventilators, companions, and so forth.

For the mere sake of strength such a structure as the trunk need only extend one half the length of the vessel, but in order to obtain uniformity of the general arrangement throughout, the trunk is gener-



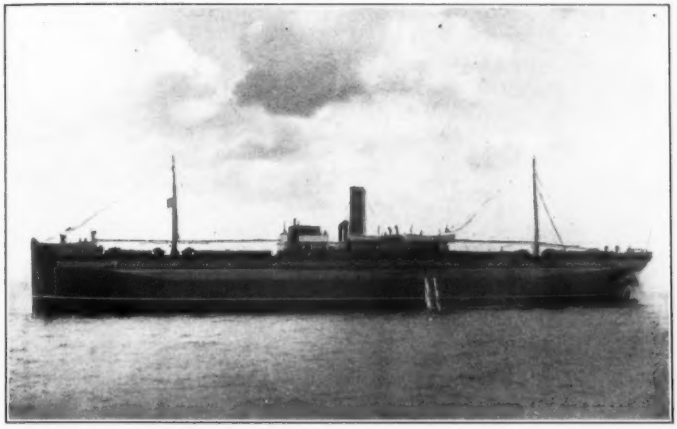
PROFILE OF A TRUNK-DECK STEAMER.

ally carried to the after-end of the forecastle and fore-end of the poop. It is not connected to these erections, however, but a passage way is left at each end to enable the crew to pass from one side of the main deck to the other without having to ascend to the trunk deck. By keeping the erections separate, better accommodation is permissible in the forecastle and poop; and the short wells that are thus formed prevent seas that find their way over the forecastle or the poop from travelling the whole length of the navigating platform, and imperilling the safety of hatch openings, deck machinery, deck pipes, officers, and

A DOXFORD TURRET SHIP A TYPE OF BULK CARGO CARRIER CLOSELY ALLIED TO THE TRUNK-TYPE VESSEL.

crew. Any seas shipped descend from the forecastle or poop direct to the main deck, and return through the clearing ports at the sides into the sea without reaching the trunk deck at all. By this method of construction, every cargo hold in the vessel is provided with a trunk and is thus self trimming. The trunk also forms a navigating platform throughout the whole length of the vessel, beyond the reach of any seas, and a place of safety for all vulnerable parts on the deck. Short, narrow gangways are usually fitted between the trunk and the forecastle, and the trunk and the poop, so as to enable the crew to pass the whole length of the vessel without having to descend to the main deck.

It will be noticed from the profile of the trunk-deck steamer that the sheer of the top of the trunk differs from that of the main sheer,



THE FOREST BROOK. A TYPICAL SELF-TRIMMER.
Midship section of this vessel is shown on page 160.

and is practically straight. This somewhat reduces the capacity in the end holds, resulting in less strains in the loaded vessel, but it increases the capacity in the trunk aft relatively to the forward trunk, which relative increase, though small, suffices to make vessels of this type trim by the stern, like the old raised-quarter-deck vessels, even when loaded

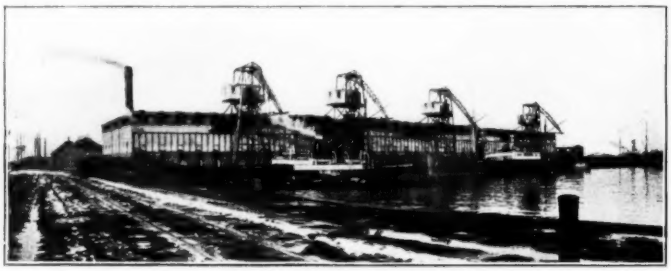
THE WHALEBACK. A SPECIAL TYPE OF VESSEL FOR BULK FREIGHT DEVELOPED ON THE AMERICAN GREAT LAKES.
The vessel shown is the Thomas Wilson, 308 x 38 feet, 1,713 gross tons.

B. D. WOOD'S COAL-LOADING WHARF, NEW ORLEANS, LA.

New Orleans is likely to attain prominence as a direct port for ocean shipment of coal brought wholly by water from the Pennsylvania fields. The plant was installed by the C. W. Hunt Company.

with homogeneous cargo, such as grain, with which the English outward coal-freighted vessel has frequently to return.

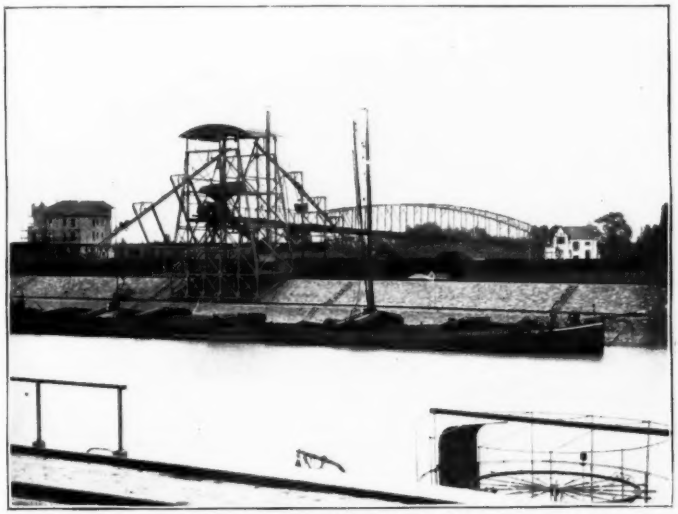
There are other advantages to which the trunk-deck type of vessel lends itself, and amongst these may be mentioned ventilation and ballasting. In many of the vessels constructed by Messrs. Ropner and Son, hollow stanchions, or pillars, are used with advantage to effect this purpose. These ventilator stanchions serve the double purpose of supports and ventilators, and their use has proved satisfactory in all the vessels in which they have been fitted. Many schemes for ballasting self-trimmers otherwise than by the ordinary double bottoms have been suggested, but so far none appear to have met with any great measure of success. I believe, however, that vessels have been fitted with the corner tank arrangement invented by Messrs. T. L. Livingston and J. Sanderson. And here, as an exception, I may state that some of the later self-trimmers have sheer, and therefore do not trim so well by the stern as the earlier and, if we may so call them, non-sheer vessels did. The tendency is to increase the size



DANISH COAL COMPANY'S WHARVES, COPENHAGEN.

C. W. Hunt Company's coal-loading appliances at the great free port which seeks control of the commerce of the Baltic.

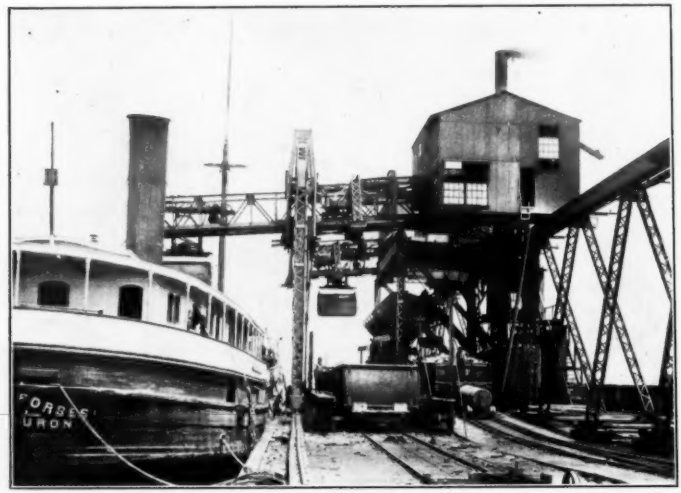
and speed of all steamers nowadays, and the rule holds good in regard to self-trimmers. Many of them will carry 7,000 tons of coal as cargo at 11 knots, and there is sufficient evidence to support the view that the larger the vessel the more economical, in proportion, is the coal consumption. A return now before me, in which are given the results of a large number of voyages by different ships, shows that a 9,000-ton steamer, running 267 miles a day, had a consumption of .036 lb. of coal per ton displacement per mile. An 8,000-ton steamer, running 266 miles a day, used .038 lb., while a 7,000-ton vessel, steaming 264 miles a day, burned .048 lb. A 6,000-ton steamer, going 257 miles a day, used .054 lb. of coal per ton displacement, and a 5,000-ton



HUNT ELEVATOR AND AUTOMATIC RAILWAY, LUDWIGSHAFEN, THE GREAT INTERIOR GERMAN PORT AND CENTER OF COAL DISTRIBUTION FOR THAT PART OF EUROPE.

steamer, travelling 260 miles a day, .067 lb.; while a 4,000-ton steamer, going 269 miles a day, consumed .081 lb. These figures show in each case speeds of close about 11 knots, and they also show that the cost of the 9,000-ton steamer for coal was less than half that of the 4,000-ton boat, per mile per ton displacement, showing that the larger the steamer the less the coal consumption *pro rata*. In regard to this question of increasing the size of our ships, the same question was raised by Professor Biles at the last meeting, in London, of the Institution of Naval Architects, in his paper "On Large Cargo Steamers." The author of the paper, in dealing with the question of the effect of

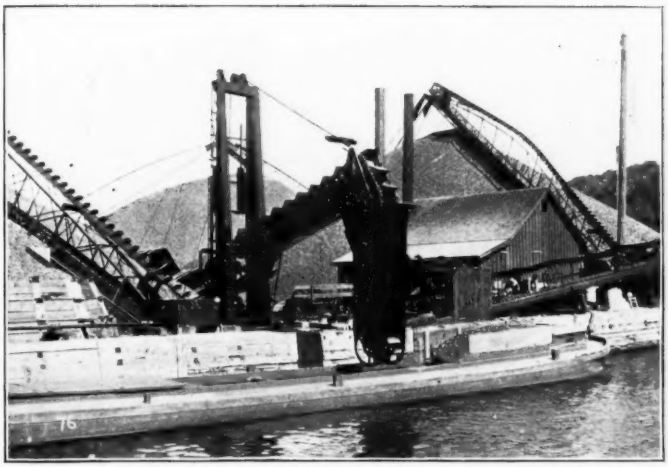
increase of size upon working expenses, including coal, wages, etc., showed that these items were less per ton carried in the large than in the small steamer. Taking a steamer 500 feet long and 60 feet broad, with a draft of 27 feet 6 inches, he found that by increasing the length to 700 feet, with a proportionate increase in the breadth, but keeping the draft constant at 27 feet 6 inches, the cost of carrying a ton of cargo 5,000 knots, at a speed of 12 knots, increased from 8s. 6d. to over 11s. But if the draft, instead of being kept constant, was increased in proportion to the other dimensions, then the cost of carrying a ton of cargo 5,000 knots at 12 knots decreased from 8s. 6d. in



RAPID COAL-HANDLING PLANT FOR CAR DUMPING, T. & O. C. R.R., TOLEDO, OHIO.
Brown Hoisting & Conveying Machine Co.

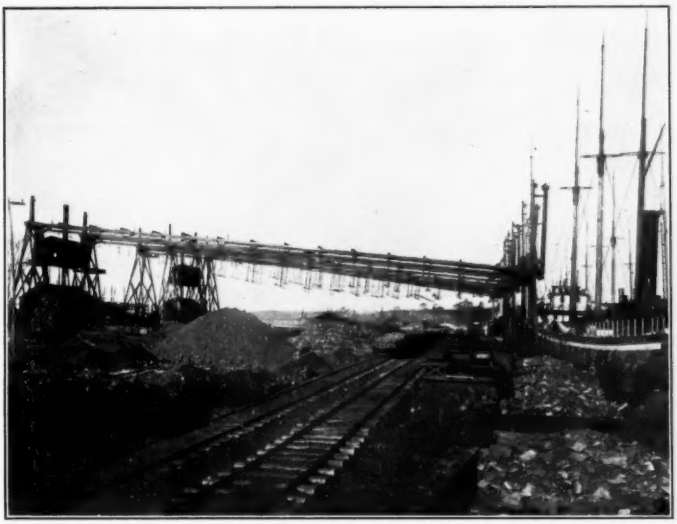
the case of the 500-foot ship, to 7s. in the case of the 700-foot ship. The question of draft is, therefore, a very important factor to remember in the design of our modern mammoth cargo carriers.

In my opening sentences, reference was made to the first steam collier, the John Bowes, plying between the Tyne and London, and for purposes of comparison with the large ships of the present day her dimensions may not be here considered out of place. She was a three-masted iron screw steamer, schooner-rigged, and was built by Palmer Bros., Newcastle, in 1852, her length being 150 feet, breadth 25 feet 7 inches, and depth 15 feet 6 inches. Her net tonnage was 270 tons, and she was fitted with engines of 60 indicated horse power. This lit-



DOCK LEG ELEVATOR HANDLING COAL FROM BARGES TO WHARF STORAGE.

The machine is adjustable at both out-board and in-board ends, and has a capacity of 120 tons an hour. Link Belt Engineering Co., Philadelphia.



BRIDGE TRAMWAY MACHINES FOR COAL HANDLING, WHARVES OF L. S. & M. S. RAILWAY, ASHTABULA, OHIO.

Brown Hoisting & Conveying Machine Co.

tle craft may be undoubtedly considered the forerunner of our present steam ocean colliers.

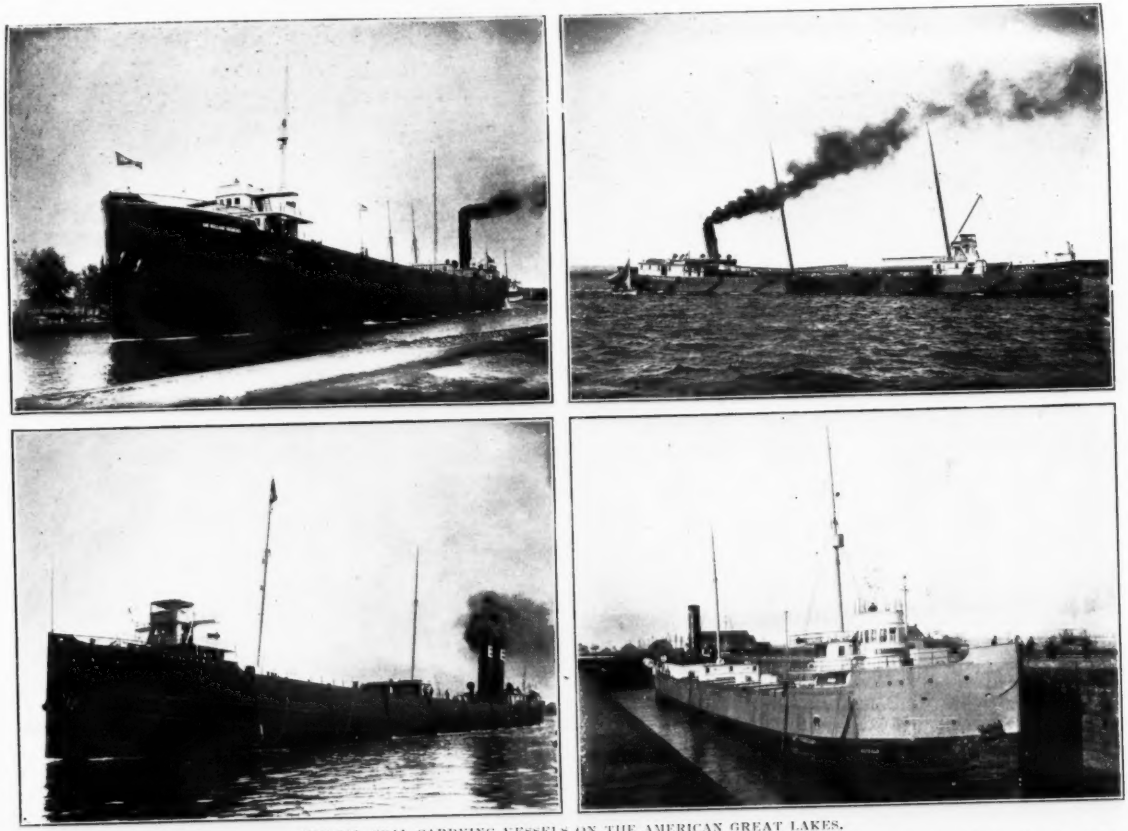
Though I have consistently advocated the self-trimming steamer as being most suitable for the duties of an ocean collier, I am not unmindful of the old saw that anything with a bottom to it will do to carry coal. But to the coal shipper, as to all other shippers, the question of speed—that is, economical speed—must ever be paramount, and I have said sufficient to show that the big trunk steamer moving at 11 or even 12 knots, is the vessel most suited to meet all the requirements of the coal trade.

I stated in the opening that the oversea coal trade of the world last year might be taken at 62,500,000 tons, and it may be assumed that the

THE COAL CARRYING SCHOONER. THE TYPICAL COLLIER OF THE ATLANTIC COAST OF THE UNITED STATES.

The Cactus, shown in the engraving, is 149 x 34 feet, and of 534 gross tons.

present coal output of the whole world may be taken at 700,000,000 of tons a year. There is practically no limit to the possible increase of the supply of coal, and as the population of every country increases so will the need of coal increase. At present the demand for coal by the world's great industries is ahead of the supply; how long it will keep so remains to be seen. Certainly the period will be shortened, so far as Great Britain is concerned, if American coal can be imported at a sufficiently low price—in other words, when American ship-

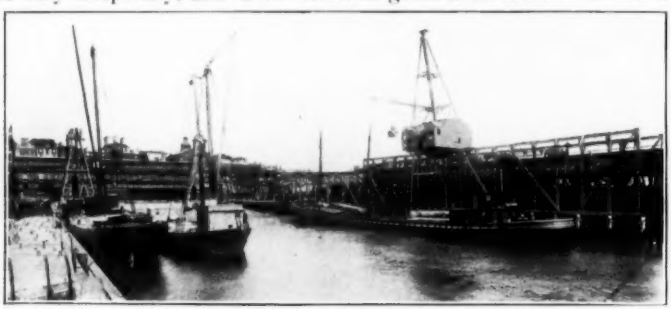


TYPICAL COAL-CARRYING VESSELS ON THE AMERICAN GREAT LAKES.

The vessels on the left are the Sir William Siemens, 413 x 48 feet, 4,344 gross tons, and the Samuel F. B. Morse, 456 x 50 feet. On the right are the Lackawanna, 260 x 30 feet, 2,015 gross tons, and the Buffalo, 258 x 35 feet, 1,762 gross tons.

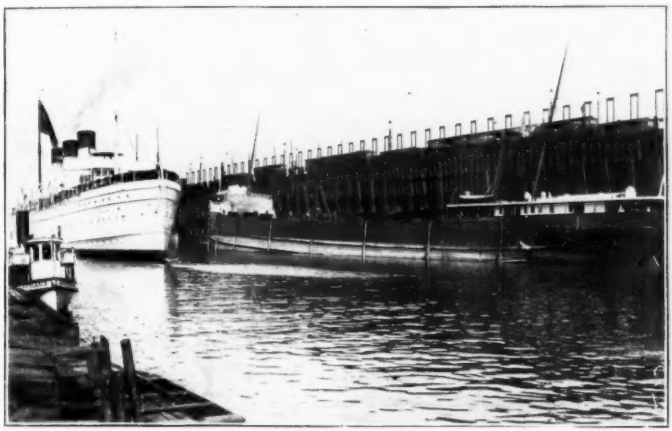
TYPICAL LAKE COLLIERS—WHALEBACK, BARGE, AND STEAMER—AT COAL-LOADING PIER, BUFFALO, N. Y.

owners, or, failing them, coal owners themselves, find it worth their while to build ocean colliers on a sufficiently large scale. The average cost of coal per ton at the pit head in the United States is given on a computation based on the returns for 1896, as 4s. 9½d. per ton, as compared with 5s. 10½d. in the United Kingdom, 6s. 11d. in Germany, 7s. 7d. in Belgium, 8s. 8d. in France, 5s. 9d. in New South Wales, 10s. in New Zealand, and a fraction over 5s. in Japan. If therefore, American coal owners can scarcely yet hope to break, with any profit to themselves, the proverbial record of "sending coals to Newcastle" they have still other countries open to them. As competitors, British coal sellers are already beginning to feel more severely than may be pleasant the presence of American coal in markets in which English coal has hitherto been supreme. This may, of course, be only temporary, and is no doubt in great measure due to the war



COAL-HANDLING MACHINERY, MASSACHUSETTS WHARF COAL CO., EAST BOSTON, MASS.
By the C. W. Hunt Co.

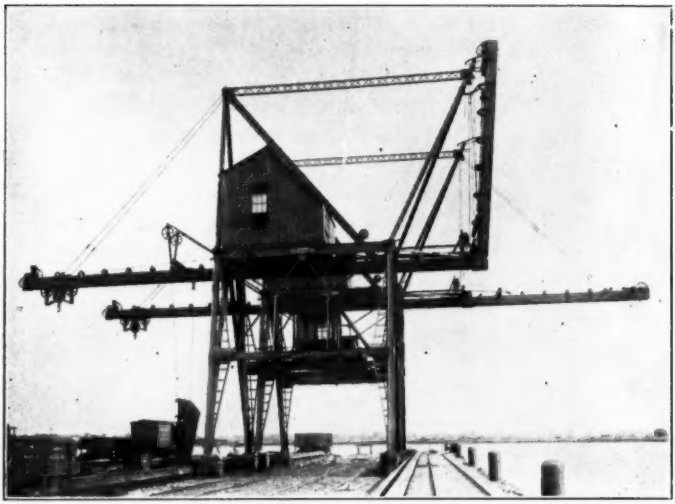
in South Africa, the advance in freights, the pressure on English coaling stations, and to the great advances in coal prices in Cardiff and Newcastle. But whether or not we regard the presence of American coal in domains that England formerly considered sacred to the home product as temporary, the fact remains that American coal is now being shipped to Barcelona, Marseilles, the Canaries, the River Plate, Rio de Janeiro, the West Indies, the Straits, and China, while quite recently a cargo of coal was shipped from Norfolk, Virginia, to Nagasaki. The striking feature of this last shipment lies in the fact that the



LAKE COLLIER AND PASSENGER STEAMER NORTH LAND COALING AT LACKAWANNA COAL CHUTES, BUFFALO, N. Y

celebrated Takashima mines lie at the entrance to Nagasaki harbour and the coal from these mines has hitherto been able to retain most of the coal trade in that part of the world. Though England did not supply the cargo (it amounted to 6,000 tons), it is at least some consolation to know that it was carried in a British ship, the Needles, a vessel of 2,995 tons net.

Having found the markets for their coals, it is but reasonable to expect that American capital and enterprise will soon provide the ships to carry them in, and we shall expect to see many a self-trimmer flying the Stars and Stripes in the near future. Nor can we, after a careful review of the coal resources of the United States, of the exceptional ease and cheapness with which they can be mined, and of the readiness with which the very best coal in the States can be brought to the seaboard, but admit that America will, in the near future, be Eng-



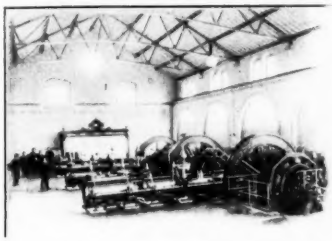
"FAST-PLANT" MACHINE FOR COAL HANDLING, PORT RICHMOND COAL WHARVES, P. & R. RAILWAY, PHILADELPHIA.

Each of the two machines is operated electrically from the small house. Brown Hoisting & Conveying Machine Co.

land's most active competitor in the coal trade of the world, and, next to the English, the largest owners of specially-designed and economically operated ocean colliers.

THE DEVELOPMENT OF ELECTRIC RAILWAYS IN ITALY.

By Enrico Bignami.



AS compared with the cost of steam power, the relatively small cost of water power in Italy—especially in the northern portion, where it is abundant—has contributed no little to the application of electricity for traction purposes. This, however, does not imply that all traction plants in Italy are worked by water power; many of them are operated by steam, and among them some that have shown excellent financial returns.

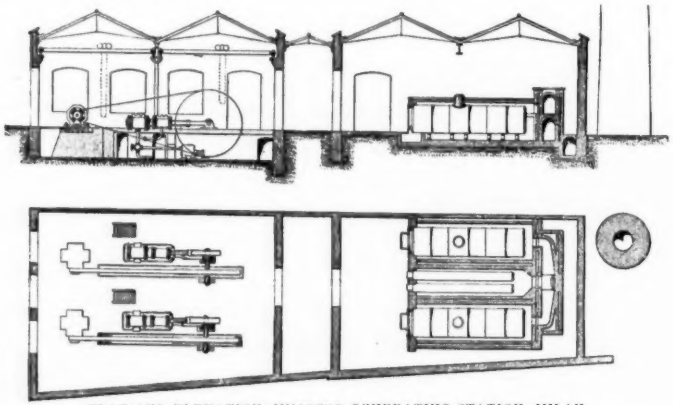
In point of time, the first electric tramway in Italy was that between Florence and Fiesole, upon which service was begun now nearly ten years ago, in September, 1890; it was originally built with Sprague apparatus, now partly superseded by Thomson-Houston equipment. At that time there were no builders of electric-railway equipment in Italy, on which account the "Compagnie Thomson-Houston de la Méditeranée" undertook to establish, then and there, a large branch office in Milan. There soon appeared in Italy, especially at Milan, Savigliano, and Turin, excellent constructing firms.

The Florence-Fiesole line, with one branch, was 4.53 miles long and of standard gauge of 1.435 metres (4 ft. 9¼ ins.), with Vignole rails of 50-pound section. Its maximum grade was 8 per cent., and its curves were of 59-feet minimum radius. The power plant was furnished with two steam engines of 92 horse-power each, and the conducting system was the overhead trolley, working at 500 volts. There were ten motor cars, each seating 24 passengers, with an equipment of 15 horse-power Thomson-Houston motors.

From the time of the opening of this road to traffic two years elapsed before another was constructed—the line running between the Piazza Corvetto and the Piazza Manin in Genoa, which was built in 1892, with Siemens-Halske equipment and 50-pound Vignole rails. The station was operated by two 110 horse-power engines driving two

Siemens internal-pole dynamos. The line equipment was overhead, working at 525 volts, and there were four motor cars, each equipped with two 13.5 horse-power Siemens motors.

The third line built was an experimental system, between the Piazza del Duomo and the Porta Sempione, in Milan, finished in 1893 and equipped with the Thomson-Houston system. It was extended in 1895 to the Cimiterio Monumentale and finally as far as the new Cimiterio di Musocco.



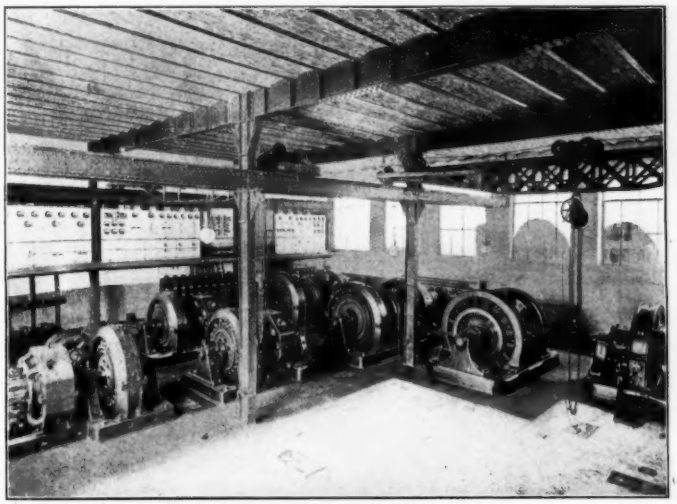
PLAN AND ELEVATION, MUSOCCO GENERATING STATION, MILAN.

The Società Generale Italiana Edison obtained a concession to build a tramway between the two cemeteries on condition that it should furnish suitable vehicles for the conveyance of the dead. For this purpose its trains are of three cars, one being a funeral car or hearse, draped in black, and the other two, intended for the friends and family of the deceased, are arranged with seats like ordinary street-cars, but are upholstered in black and blue and decorated with the arms of the city of Milan. On this line there are five motor cars, weighing 13,640 pounds each, carrying each a single 25 horse-power motor. There are three trail cars, weighing 5,720 pounds each, and four hearse cars, weighing 11,440 pounds each, these comprising the entire rolling stock of the road.

So encouraging was the experience of these two lines that it decided the municipality of Milan to enter into contract with the Società Generale Italiana Edison for the changing over of all its horse-car lines to electrical traction. At present there are, in Milan and its suburbs, 60.7 miles electrically-equipped track, with 210 motor cars and about 20 trailers in operation.

The company has three car-barns, with a capacity of 450 cars. At the end of 1899 it owned 250 cars, of which 30 were trailers and 3 sweepers, all made in Milan. The power comes from the waterfalls at Paderno d'Addo, 13 miles away, being transmitted over a three-phase line at 13,500 volts. The plant is of great general interest, its total developed energy being distributed for lighting, traction, and many and varied small industries. At the outskirts of the city the pressure on the transmission line, for the street-railway current, is transformed down to 3,600 volts, at which it is distributed to the center of the city and utilised in synchronous motor-generators, giving 550-volt direct current. The distributing network is divided into four sections supplied by twelve feeders.

In 1895 three other cities—Genoa, Rome and Varese—followed the example set by Milan. At Genoa, as was mentioned above, there was started, towards the end of 1893, a little road about half-a-mile long, but it was not until the end of 1895 that the transformation of



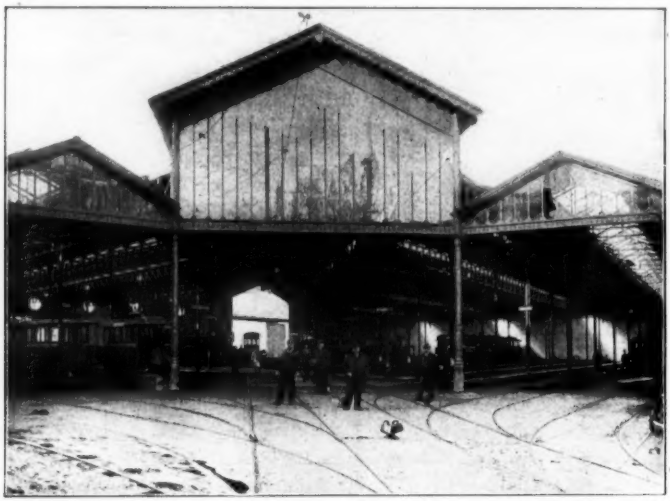
NEW CONVERTING STATION OF ST. RADEGONDA, MILAN, FOR CONTINUOUS-CURRENT LIGHTING AND TRACTION SERVICE.

the Genoese tramways was undertaken in a thorough-going manner. The numerous difficulties caused by the hilly conformation of Genoa obliged the Allgemeine Elektricitäts Gesellschaft, of Berlin, which firm undertook the construction, to bring out much interesting work on the line. All the cars were built in Milan.

Three companies operate various portions of the Milan lines: the Società di Ferrovie Elettriche e Funicolari works the lines inside the city, while the Società dei Tramways Orientali operates those on the east and the Unione Italiana Tramways Electtrici those on the west. Actually the three concerns work together according to a uniform schedule, running cars on 16 lines with a total length of 71.3 miles.

Some lines have a considerable length, for example, the Voltri-Nervi line, which is 18.6 miles long. Some have grades ranging from 4 to 8 per cent. and having sharp curves in places. In certain points it was necessary to make use of a cable system, of which there is a total length of 0.87 mile, with a maximum grade of 24 per cent. In other points considerable engineering works were necessary, as in the boring of special tunnels of relatively considerable lengths and in part underlying houses of the better class, and the grading of streets and squares. A highly interesting tunnel is that under the hill of St. Ugo, which is a spiral of from 22 to 38 yards radius, with a difference of level of 13.2 yards between the spires.

Of the 71.5 miles of track 3.75 miles are in tunnels, 1 mile cable, and 5.4 miles cable railway in tunnels. There are four grip cars, four large car barns, five small car barns and two power-houses, of 1,000 horse-power and 7,000 horse-power respectively, the latter being used also for electric lighting.



PORTA VOLTA CAR SHEDS, MILAN.

USUAL TYPE OF MOTOR CAR AND TRAILER, MILAN TRAMWAYS.

The first electric tramway in Rome was started in 1895, the experimental road built previous to this time by Captain M. Cattori being hardly worth consideration as a serious effort. The first of the Roman lines running between the Piazza S. Silvestro and the Piazza Venezia was installed by the Società Romana Tramways Omnibus with Thomson-Houston apparatus, and was thrown open to the public on Sept. 19, 1895.

The system was a highly interesting one, in as much as it combined at the same time a water-supply system, high-tension alternating-current supply, continuous-current supply at moderate pressure, accumulators, and the trolley system. The power station is at the waterworks at Tivoli, about 18 miles from the city. The electrical energy is here generated at a tension of 5,000 volts, alternating, and reaches Rome at about 4,000 volts. Here the pressure is reduced to 2,000 volts for distribution, and some of it is also converted into direct current at 550 volts by means of three 80-kilowatt rotary converters. A large battery of Tudor accumulators, connected in parallel with the rotaries, serves, in a way, as a flywheel for the system and provides an emergency supply of current. For two or three hours at night the railway system is fed directly by these batteries. One of the lines was operated as an experiment, with accumulator cars. The batteries used were of the light Pescetto type, and experience showed, technically

speaking, good results, but economical reasons dictated the abandonment of these cars in favour of the overhead-trolley system.

The system comprises 5,600 feet of double track, on which the grades are as heavy as 8 per cent. The curves have radii of 65 to 78 feet. The rails are of the Phœnix system, weighing 70 pounds per yard, the gauge being standard. The rail joints are bonded with two "Chicago" rail-bonds. At every 50 meters the two rails of the track are connected with a 7-millimeter copper wire, and at every 100 meters the four rails of the double track line are similarly connected. This system gives complete security against bad return connections.

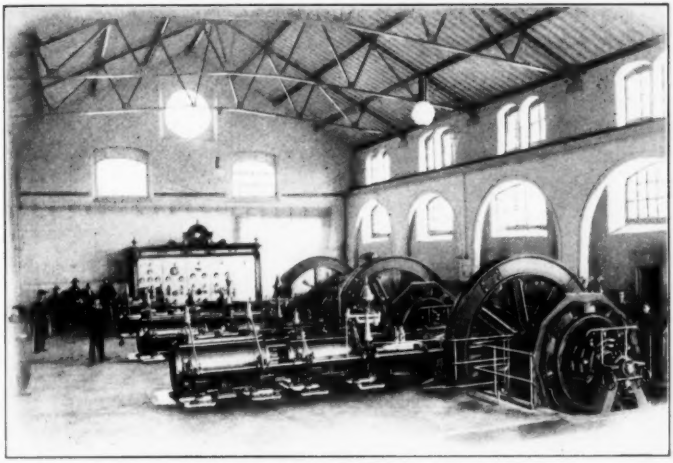
The first outfit of cars comprised 14, each seating 22 passengers inside and 8 outside. To this equipment was quickly added that of eight other lines, with a total length of 28.17 kilometers (17 miles), all operated by the Società Romana.

PIAZZA DEL DUOMO, A CENTER OF TRAMWAY LINES, MILAN.

The first electric railway at Varese was inaugurated in 1895, running from the railway station to the first chapel of the Sacro Monte—a road frequented by numerous pilgrimages—the distance being 3½ miles, with heavy grade. The track is of one-meter gauge, and upon it are operated four motor cars and four trail cars. The power house contains two Tosi 66-horse-power engines and a battery of Tudor accumulators. Here also begins an interurban line, connecting Varese and Luino.

From that time on the principal cities of Italy began gradually to transform their tramway systems into electric railways. Turin, Florence, Leghorn, Naples and Palermo followed the example of Milan, Genoa and Rome.

The principal lines in Turin were inaugurated, on the occasion of the Electrical Exposition of 1898, by the Società Torinese Trams e Ferrovie Economiche, using Schükert* apparatus on 19.106 kilo-



ENGINE AND DYNAMO ROOM, LEGHORN GENERATING STATION.

meters (11.84 miles) of track, and by the Società Anonima di Elettricità Alta Italia, using Siemens & Halske apparatus on 8.68 miles of track, to these being added in 1899 other lines, partly urban and partly interurban, of a total length of 17,061 kilometers, so that the beginning of this year found a total of 50.284 kilometers (31.18 miles) of electric tracks in Turin.

The plant of the Alta Italia company is of great interest, since it comprises a five-wire direct-current distribution for lighting in parallel with the trolley system, and a mixed traction system, using both trolleys and accumulators. The generating system is, in part, outside

* The Schückert concern, of Nuremburg (Aktien Elektricitäts Gesellschaft, vormals Schückert & Co.), has established the following Italian sub-companies: Società Nazionale, of Milan, capital 5,000,000 lire, La Società Lombarda per la Distribuzione di Forza, of Milan, capital, 8,000,000 lire; The Società Toscana, of Florence, capital, 2,000,000 lire; The Società Torinese dei Trams e Ferrovie Economiche, of Turin, capital, 4,500,000 lire; The Società Siciliana dei Trams e Omnibus di Palermo, of Palermo, capital, 1,000,000 lire. The Central Company of Palermo, with a capital of 2,500,000 lire constructed a part of the Turin traction system and has a contract for that of Bergamo. The lira is equal to the franc — substantially 19 cents or 9½d.

of the city. Direct current at 550 volts is generated by three Siemens internal-pole, 600-kilowatt generators, direct-coupled to Tosi engines. The motor-generators in the station are operated by current coming from Lanzo, 19.8 miles away.

The cars are fitted with Siemens bow trolleys and accumulators also. In the central part of the city the trolley is tied down, and the car is operated on the batteries alone. No change of electrical connection is involved in passing from one system to the other. At present forty motor cars, with twenty trailers, are in use. Each motor car

ALONG THE HARBOUR, LEGHORN.

is equipped with two motors, seats 40 persons, and weighs, complete with its battery, 14 tons (metric).

The Società Torinese equipment is entirely overhead, the company having paid to the municipality 1,000,000 lire for permission to abandon the mixed system. When the Alta Italia company made application for permission to abandon the mixed system in favour of the trolley, the communal council of Turin unanimously approved an ordinance requiring the company to pay a fixed tax of 2 centésimi per car-kilometer, for both trailer cars and motor cars, the profits of the undertaking to be equally divided between the company and the municipality. Under these circumstances the present concession was preferred, and has been extended for ten years.

The equipment of this system (Società Torinese) is very like that

in use in the United States. The power plant has multitubular boilers furnishing steam to three Tosi compound engines direct-coupled to Schückert dynamos of 500 horse-power each.

Among the Turin systems should also be mentioned a section of experimental line built by Sig. Alfredo Diatto between the shops of Messrs. Tedeschi & Co. and the Lanza gate. This surface-contact system was first adopted for the Tours tramway and afterwards for about 50 miles of line in Paris.

Another Italian inventor, a priest, Monsignor Luigi Cerobotani, has recently contracted with a Veronese establishment for the construction of a trial system of electric trams. The conductors used are simple insulated-copper wires running along under the track. The rails, which are used for picking up the current, are not continuous,

LEGHORN, SHOWING ELECTRIC RAILWAY LINE IN THE FOREGROUND.

but are divided into sections, insulated from one another, so that the track may be considered as forming many pairs of current-carrying pieces. Each rail of each pair can be connected with one of the copper conductors by means of a lever switch, which is closed by the passage of the car. For this purpose the car is furnished with two iron bars magnetised by electro magnets operated by the propelling current.

At Florence the inauguration of the first Florence-Fiesole line waited eight years after the line from the Piazza del Duomo to the Viali di Circonvallazione (3.8 miles) was completed, but the latter

was soon followed by other lines, so that at the first of this year the Florentine system, all operated by the Société des Tramways Florentins, had a total extension of 25.75 miles. The lines comprise three principal systems, radiating from the Piazza del Duomo, the center of the city, to the suburbs, and subdividing into seven lines. A belt line built along the fortifications completes the system.

The power house is rectangular in form and is located on the belt line at the point where the Fiesole line crosses it. In the boiler room is a battery of four boiler units, of the Weinlig system, having superposed cylinders. Each boiler can give from 2,500 to 3,000 kilograms of dry steam per hour at a pressure of 125 pounds. Each boiler carries a steam-trap, of the Schwörer system, furnished with a safety-valve. A Green economiser is interposed between the boilers and the chimney, which is 186 feet high. Feed water, after passing through a Desrumeaux purifier, is received in a reservoir, and thence pumped, by means of two feed-pumps, through the economiser to the boilers. The engine room is equipped with three horizontal compound engines of the tandem type, adapted to exhaust either to a condenser or into the open air. The generators are direct-coupled to the engine. Two of the units are of 700 nominal horse-power, each at a speed of 120 revolutions per minute and with a steam pressure of 120 pounds and a vacuum of 26 inches. The third unit runs at the same speed, but is of only 350 horse-power. The two large engines are each coupled to an 8-pole, 425 kilowatt Thomson-Houston generator, giving 500 to 550 volts. The smaller engine drives a 6-pole, 225-kilowatt machine of the same type.

The supply feeders for the system are laid underground in the central part of the city, and consist of two strongly insulated and armoured cables 500 and 250 square millimeters in section, connected in with the trolley line at the junction points through switches. In the suburbs all the feeders are overhead, consisting of bare copper cables of 250 or of 125 square-millimeter section. The rails are connected by means of two "Chicago" rail-bonds 9 millimeters in diameter at each joint, and the rails are cross-connected at every 50 meters by a tinned copper wire of the same diameter. Return feeders are made of old rails of 60-pound section, well connected together, and buried about 30 inches below the tracks.

The rails used in the city are of the Broca type, having a 65-pound section and made in 32.8-feet lengths, while the suburban sections are laid with 50-pound T-rails. Seventy-five motor cars are in use, of which sixty are closed cars, each equipped with two General Electric

25-horse-power motors, ten are open cars, with two similar motors, and five are closed cars, with two 50-horse-power motors on each. The latter cars are used to haul in and out of the city trains from external lines using steam locomotives outside the fortifications. A considerable number of trail cars are also in use. All the motor cars have electric brakes.

At Leghorn the Società Anonima delle Tramvie Livornesi threw open to the public on October 14, 1899, its first line through San Marco Antignano, 4.8 miles long. The track is of standard gauge. Two engines of 50 horse-power each furnish power for three motor

A FLORENTINE ELECTRIC TRAMWAY.

cars. At the end of 1899 the track had been extended to 6.92 miles.

At Naples, since the first trolley line was completed, in January, 1898, by the Società Anonima dei Tramways Napoletani, with 3.5 miles of track, four others have been constructed, with a total of 8.35 miles. To these will very soon be connected a line through Sorrento to Castellamare di Stabia.

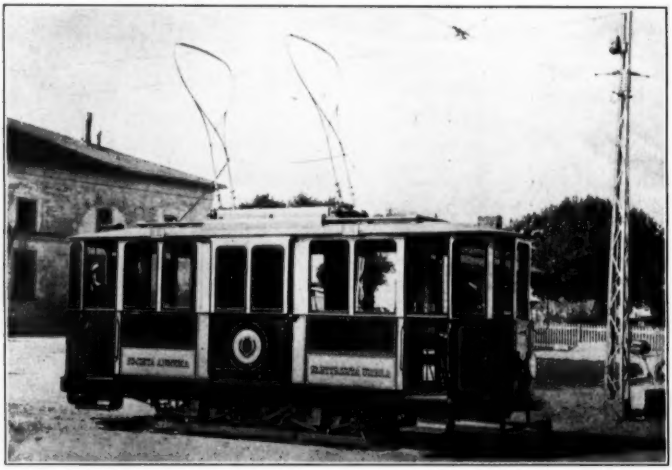
At Palermo there are now three lines—those of Piazza Bologna to Rocca, of Piazza Independenza to Romagnolo, and that of Palermo to Monreale, with a total length of 9.67 miles.

The example set by the larger cities was followed in the smaller ones; Nervi has a line to Rocca; Perugia has a one-meter gauge line 2.65 miles long; there is a line from Prato to Rocca, and Bergamo has

a line a mile long from the railway station to the foot of the cable road. Between Milan and Monza, on the track of the Mediterranean railroad, an experiment has been in progress with accumulator cars.

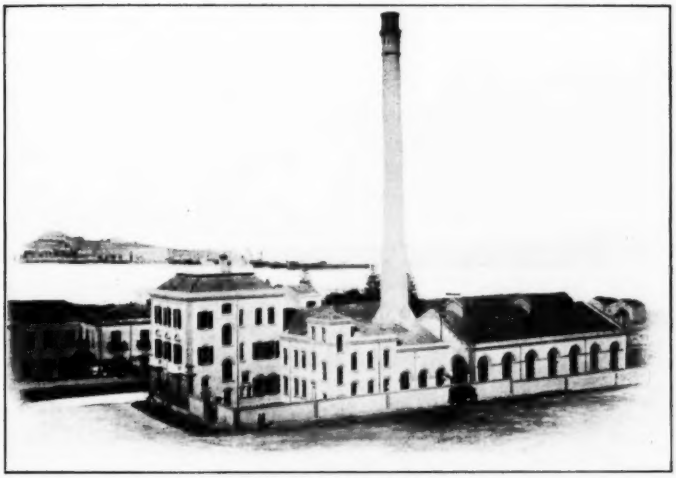
For some time there have been electric tramways at Como, at Catania, Spezia and Brescia, using "Helios" apparatus, which is also being used in lines under construction near Genoa and Florence, and also lines between Milan and Affori and Milan and Corsico.

At Como the Helios company had already installed and operated a line from the railway station to the Piazza del Lago during the exposition of 1899. Now it is negotiating for taking up the line again and extending it to Camerlata, 3.2 miles, and to Chiasso and Cernobbio, 7.45 miles.



ELECTRIC CAR, PERUGIA, SHOWING SLIDING CONNECTIONS.

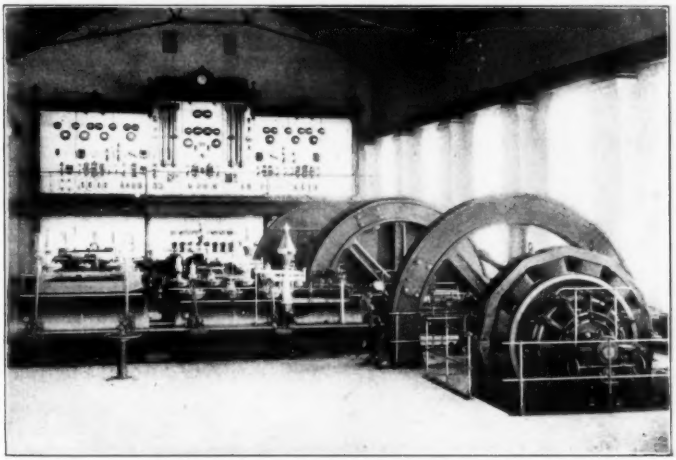
The Catania concession was held by Singer & Co., of Berlin, and the construction work was done by the Helios Company, of Cologne. The total length of the lines is 19.8 miles, of which half is in the city and half in the suburbs. The system is the familiar trolley, with 500 volts' pressure. The power plant also furnishes current for lighting, and absorbs about 400 horse-power. There will be installed four dynamos of 500 kilowatts, giving three-phase current at 3,000 or 4,000 volts. For the railway the current will be transformed and changed to direct current by rotaries working in two sub-stations, one in the city and the other in the suburbs. Steam power will be used exclusively, and the power plant will be near the sea, a maximum distance of about



CENTRAL STATION, PALERMO.

4.35 miles from the point of application of the power. In the city cars on single trucks and carrying thirty passengers will be used, while the suburban service will be performed by double-truck cars seating forty. Work on the system is going ahead now and will be completed in two years at a cost of about four or five million lire.

The plant at Spezia is now under construction by the Società



DYNAMO ROOM PALERMO GENERATING STATION.

ROCCA-MONREALE LINE, PALERMO.

Italiana Industrie Elettriche. The finished track will be about 12.4 miles long, of standard gauge. The overhead system, with bow trolleys, will be used. Two 250 horse-power Tosi engines will drive two Helios dynamos and boosters, which will be used in connection with a battery of accumulators. It is thought the line will be open in the autumn of 1900.

To sum up, there were, on December 31, 1899, 244.5 kilometers (153.6 miles) of electric tramways, nearly all of standard gauge, in Italy. Of them the greater part operate on the trolley system, using Thomson-Houston, Siemens & Halske, Schückert & Co., and Helios equipment.

Of mechanical-traction systems in use in the Kingdom of Italy at the beginning of this year, there was, according to a report of the Ministry of Public Works, a total length of 3,179.5 kilometers (1,971.3 miles), of which only eight per cent. was electrical. More than 600 miles of these urban and interurban lines are now in course of transformation to electric systems. In this way are projected—and in part the concessions have lately been obtained—electric railways between Alessandria and Valenza, between Cuneo and Pesio, between Vercelli and Crescentino, between Padua and Vicenza, Como and Seregno, Bergamo and Treviglio, Reggio d'Emilia and Castelnuovo dei Monti, Ferrara and Pontelagoscuro, Castel Raimondo and Camerino,

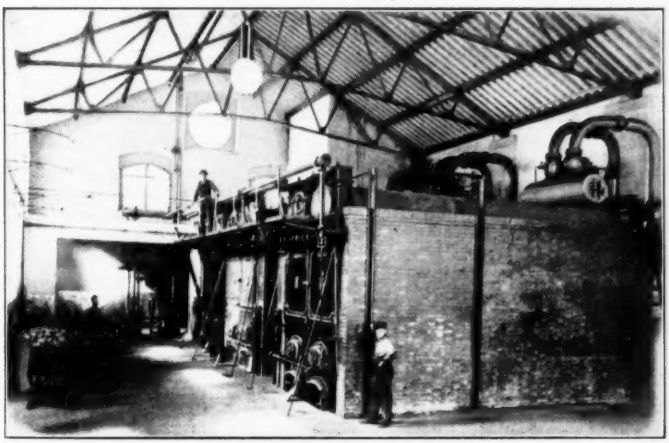
Rome and Ostria, Cassino and Sora, etc., and all of these are understood to have sufficient capital (which finds a certain remunerative investment in such enterprises), and will be completed in a short time. The new lines will restore the status of many old lines and render profitable the transformation or construction of many new ones.

Geographically speaking, the cities of Trieste, Fiume, Lugano, Mentone, and Nice belong to Italy, and it will not be out of place to mention briefly the electric tramways installed in them.

There is no line in Trieste now, but one will soon be put in by the Union Elektricitäts Gesellschaft, of Berlin. This installation presents no unusual features. The tramways at Fiume are under construction by the same company.

Lugano was the scene of the first experiment in polyphase electric traction in Europe. A 75-kilowatt, three-phase alternator is used, working at 5,000 volts, and feeding, through transformers, lines at 400 volts in the town. There are three lines, 2.8 miles long in all, having four motor cars. The power is generated by a waterfall at Maroggia, 7.4 miles from Lugano.

Nice has had, for several months, a system of electric lines that will be extended through the Riviera so as to embrace, finally, about 93 miles of tracks. The system of Nice proper comprises the old horse-car line and new lines built since the transformation. On this system mixed traction is still in use in the central part of the town. In the streets through which the carnival procession passes conduits



BOILER ROOM OF THE LEGHORN GENERATING STATION.

of the open-slot kind are used, while in the outlying districts all the lines use the trolley.

The Littoral lines, which are about 31 miles long, include: 1. A line from Cannes to Mentone; 2. A branch line which runs to Nice, Piazza Garibaldi, and to the village of Cantes-les-Pins; 3. A system of lines in the city of Mentone. From that place a line runs to Ventimiglia, and further to Bordighera, as described above.

TRAMCAR, PALERMO-MONREALE LINE.

In addition to all these lines of local interest, there are the main-line railways. A vast field of operations is henceforward open in Italy for the application of electric traction on railways. Great ease in developing water power, united with a scarcity—not to say an absolute deficiency—of coal, has led the great railway companies to study the question seriously. Nothing seems to stand in the way of operating nearly all of their lines by means of electricity. Perhaps, with the actual present scientific and industrial development, it may not always be feasible, but it is certain that many lines would gain in economy of operation by substituting electric traction for steam.

The government commission appointed to study the question of electrical operation of railroads has concluded that it cannot be solved without experiment upon the following systems:

1. Cars with accumulators of the Planté type.
2. Cars with accumulators of the Pescetto type.
3. Overhead three-phase high-tension system.
4. Third-rail system with direct current.

Experiments with Planté accumulators are being made on the Milan-Monza line by the Mediterranean company. The Adriatic company proposes to undertake experiments with the Pescetto system on the Bologna-San Felice line. The same company will put the overhead system to test on the Lecco-Colico-Sondrio and Colico-Chiavenna lines. These will be most complete experiments on the transportation of goods and passengers under service conditions, and along with them will be made an attempt to supply electrical energy for industrial uses. The Mediterranean company will experiment definitely with the third-rail system on the Milan-Gallarate-Porto Ceresio line.

From experiments lasting more than a year on the 9-mile long Milan-Monza line, with cars equipped with Planté accumulators, running on the Mediterranean company's tracks at a speed of 26 miles an hour, the following data have been obtained: The weight of the car, which carries 100 passengers, is, without the live load, 127,600 pounds, approximate, distributed as follows:

	Pounds.
Car proper	74,800
Motors, controllers, cylinders and accessory compressor for Westinghouse air brake	11,000
Battery of accumulators for traction	39,600
Battery of accumulators for lighting	1,100

The weight of each element of the traction battery is 241 pounds, the total weight of plates in the 130 elements being 30,000 pounds. The remainder of the battery weight is due to the heavy lead connectors, the cells, and the electrolyte. The mean discharge current on the Milan-Monza run is from 230 to 250 amperes, and for over a third of the distance the battery is not used at all. The battery is charged up to 275 to 280 volts on open circuit, and makes one round trip on a single charge, its open-circuit tension falling to 260 volts at the end of the run, or 2 volts per cell. The two motors on the car were made by the Schückert company, the accumulators and cells by the Hensemberger firm of Monza, and the cars were built by Messrs. Crondona, Comi & Co., of Milan. The technical results of the test have been highly satisfactory, but there is room for improvement in the economical showing.

The Bologna-San Felice line, which has just started, for passenger

service only, with accumulator cars of the Pescetto type, is 26 miles long, with four intermediate stations. Three cars from the Diatto shops, in Turin, equipped with motors by Ganz & Co., of Budapest, comprise its equipment. The charging station is in the railway station at Bologna. It receives polyphase current at 3,000 volts and transforms and converts it to direct current at 500 to 750 volts through the medium of two motor-generators of about 100 horse-power each.

The Secco-Colico-Sondrio line, upon which the high-tension three-phase system using an overhead trolley, will be installed, is 65 miles long, and may well claim to be the first example in Europe of an important main-line electric railway. The motive power under development for it is about 7,400 horse power, and may be increased as the demands of passenger or goods traffic may necessitate. Power is derived from a waterfall near Morbegno, 9.4 miles distant from Colico and 15.5 miles from Sondrio. The head race for carrying 25 cubic meters of water per second, with a fall of 30 meters, will be 2.8 miles long, of which a little more than half is tunnels, the remainder being open cutting. Four units of water-wheels and dynamos will be installed in the power-house, each of about 2,000 horse-power capacity, generating current directly at 20,000 volts. These generators and the distributing switchboard will be furnished by Schückert & Co., while Ganz & Co. will construct the other parts of the electrical equipment, including the line and rolling stock. A contract has been let to the Società Italiana per la Trazione Elettrica sulle Ferrovie for the work, and this company will also operate the road for some years.

This is the first application of so high a tension to traction work with us, and the experiment is awaited with the utmost interest. A pressure of 20,000 volts will be fed directly to the overhead conductors. Every 10 km. (6.2 miles) a transformer station will be established, reducing the pressure to 3,000 volts, which will be the service pressure. Two of the conductors of the three-phase currents will be overhead, the rails forming the third. The method of insulating the trolley line under this high tension, as well as all parts of the electrical equipment, presents a number of novelties of design well worthy of attention. Trains will be light and will be run at short headways. The passenger and freight services will be entirely distinct from one another. Passenger cars will be provided with their own motors. Each car is on two four-wheel trucks, and every car carries four motors. Of these only two work normally, the other two being used on up grades. Schedule speed will be 60 km. (37.2 miles) an hour on the level and about half this on grades. All regulation is accomplished in the rotor

circuits of the motors, their stators being connected directly with the 3,000-volt line and no intermediate apparatus being included in this circuit in order to avoid the danger of accidental contact with the high-tension wires. The motors are mounted directly on the axles to reduce shocks and oscillations as much as possible. The highly ingenious system of block control adopted is such that if its signals are turned to "stop," or the switches are wrong, the line current is cut off. All chance of collision is thus eliminated. As a further safeguard, the stoppage of the line current sets powerful brakes on the train, so that if it enters a block improperly it is at once stopped.

Concerning the Milan-Gallarate-Varese-Porto Ceresio third-rail work, it may be said that the total system will be about 62 miles long and is composed of a standard double-track road from Milan to Gallarate, whence branch out three lines which, running through the lake regions of upper Italy, terminate respectively at Arona, Laveno and Porto Ceresio. The work will be undertaken by the Compagnia Thomson-Houston. High-tension three-phase currents will feed the sub-stations, where it will be transformed and converted to 600-volt direct current and at this pressure fed to a third rail. The rolling stock will comprise 20 8-wheel motor cars, each carrying a single 600 horse-power motor connected with an axle by a single-reduction spur gear. On account of these powerful motors a speed of 90 km. (56 miles) an hour will be attained, even when a train of several cars is attached.

Besides these lines, the railway from Sampierdarena to Ronco, which goes through the two Giovi tunnels, will use electric traction to avoid foul air in the tunnels and difficulties due to heavy grades. With the new system, by subdividing the tracks into short blocks, several trains may go up the grade at once. With steam traction to-day the maximum is 49 goods trains and 15 passenger trains a day, but with electric traction 95 freight trains of 20 cars each and a large number of passenger trains can ascend the Giovi grade daily in perfect security. At Sampierdarena a steam-power generating station will supply high-tension three-phase current to sub-stations at Mignago and Ronco, where the usual equipment of transformers and rotaries will reduce it to 700-volt direct current for the working conductors. Twenty-three electric locomotives of 40 tons and 544 horse power each for freight trains and 840 horse power each for passenger trains, will take care of the service referred to above. The plant as outlined will be sufficient for the needs of the port of Genoa for several years, which will give time to survey and execute another Transappenine artery of commerce.

PIECE WORK AS AN AGENCY IN MACHINE-SHOP COST REDUCTION.

By M. Cokely.

QUESTIONS affecting the relationship between employer and employee are of intense interest—particularly so to those whose duty it is to harmonize their conflicting views. Of these questions the greatest is that of remuneration, its extent and method. From the fact that the aim of the world at large is to get all it can, we would naturally suppose that extent would be the only view to consider; this is not the case, however, as labor unions, particularly in the metal trades, seek to subordinate extent to method—that is, they refuse to allow their members to receive a large wage if it is earned by piece work. This is particularly true of the machinists.

As piece work is purely a merit system, tending to excite ambition in a workman, it is consequently productive of a large day's work. Leaving envy out of consideration, the only reason we can ascribe for the workmen's hostility is the influence of that universal law of human nature, to do as little as possible for the highest wages obtainable. Through ignorance not only of the law of supply and demand—of trade and commerce—but of the very fundamental principles of manufacturing, they fail to realize that there must be a limit to the observance of this natural law—that the full realization of their natural desires is not to be accomplished in a lifetime, but will be the result of an evolutionary process requiring perhaps centuries to develop.

Human impatience, like all other explosive forces, when properly controlled is a most influential agent in bettering the condition of the human race; but it must not be allowed to burst its bounds, as it is then productive of excesses which we know are detrimental, and which must be compensated for by a swing of the pendulum in the opposite direction. We saw an instance of this in the great engineers' strike of a few years ago in England, when the rules of labor organi-

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Mr. Cokely's point of view in regarding the piece-work system is a peculiarly interesting one. It is that of a man standing between the employer and the workman, where he commands a complete view of the positions of both, and from which he directs the difficult but broadly instructive work of bringing their efforts into harmony. He speaks with an accurate appreciation of the needs of the employer and the sentiments and purposes of the men. His vital concern is to secure that which is best for both sides. The extreme practicability of his attitude will commend itself to all who are interested in works management.—THE EDITORS.

zations were so obstructive to the development of trade that the employers were compelled to fight for their very existence. Under such circumstances there need never be a doubt regarding the result of the struggle. It would seem from the actions of labor and the threats of some of its leaders, that the same mistake was to be repeated in the United States. The unions object to piece work, and to one man running two or more machines. We find them also in many cases objecting to labor-saving machinery, and, in fact, to pretty much everything that tends to cheapen or promote production.

The excuse is sometimes given that measures of this kind, which increase the productive capacity of the workman, throw others out of employment. This is the same old charge that has always been brought against labor-saving machines and methods, and its absurdity has been proven too often to receive much consideration here. It should be well understood that a certain amount of production is necessary to maintain existence. That amount varies in proportion to the increase in the population of the world, and to the advancement of civilization. As people become more civilized and enlightened their wants are increased; to meet the increase there must be a corresponding improvement in the methods of production. Stop that improvement, and you stop civilization. Nature, working through the avarice and ambition of man, supplies this improvement. The time may come when all labor will be paid according to its productive capacity—when men will be paid according to their individual efforts. Theoretically that is the only just method of remuneration. It is placing the matter where it belongs, under that inexorable law of nature—the survival of the fittest. All development is in that direction, and competition in manufacturing demands it. The observance of this law does not require that the weak should be left to suffer; but means other than the restraint of the fittest should be provided for their care.

From the published reports of the discussion on this subject at the last year's meeting of the International Association of Machinists, it would seem that the one predominant idea seemed to be the strangling of individual ambition. It is right and proper that men should stand united against oppression, or anything that serves to lower or degrade them; but I fail to see where piece work in any fair and proper form can produce such an effect. The organization that strives to curb the energies or worthy ambition of its members will come to grief, sooner or later. Enforced stagnation has no place in healthy industrial life. Had it not been for the incentive that was offered to individual energy, America would not be occupying the proud position she holds to-day.

Such a policy has produced wealthy men, practically every one of whom is a shining example of what it is possible to accomplish by well-directed efforts. All honor to those who have risen from the pick and shovel, the chisel and hammer, or the axe in the forest, to the possession of millions. The money which they control is not hoarded, but invested broadcast throughout the land, not only for their own benefit, but for the benefit of those less fortunate.

Labor organizations are certainly working on the wrong principle when they encourage their members to retard production by the performance of a dishonest day's work. They are no doubt honest in their convictions, but blind to the inevitable nevertheless. President Fox struck the nail on the head when he advised the Iron Molders' Union to cease opposition to molding machines. Suppose that advice had been given years ago, when molding machines were first introduced; or suppose there never had been opposition, but, on the contrary, the men had recognized the inevitable and accepted the machines as a benefit to the foundry business and the world in general, and endeavored to make the best use they could of them! Suppose, again, that the machinists' convention had declared for a good, fair day's work, whether they were watched or not; that they would exert themselves while running a machine, as when working at the bench or on the floor, even though it meant the running of several machines to do it; that they had given their members to understand that they were hired to work, and not to sit on a three-legged stool and watch a planer travel back and forth for hours, with practically little or no necessity for their attention, because the automatic features on that planer—or any other machine which made constant attention unnecessary—were paid for by the company, who should not be expected to make further expenditures by having them sit down and watch it do its work; that the man who attends a machine tool has no more privileges than his shopmate who swings a hammer, "pushes" a file, or jumps around an erecting floor unceasingly throughout the day—in a word, suppose they had come out boldly with instructions to their members to do everything within their power to perform a fair day's work and leave their employers no chance to say they had done otherwise, and to accept in a friendly spirit all economical methods and machines, providing they were given an opportunity to increase their earnings without detriment to their health. I do not mean to insinuate that a small day's work is the rule among machinists, but we do know that there is a great deal of what we call "hanging back," and as it is just this "hanging back" that makes piece work in some form

a necessity, one would naturally suppose the workmen would endeavor to remove the cause and place themselves in a true light and an advanced position as an organization before the world.

I fear, however, that this is asking too much of human nature, and that systems of reward and penalty must be employed to obtain the desired result. The system in general use is piece work in various forms. Plain old-fashioned piece work, with a definite price on every operation, is the oldest and best known; it has its friends and its enemies, just as it has been properly or improperly applied. There are hundreds of factories where it is in successful operation, many of which would now be out of existence were it not for the benefits of the piece-work system. The principal objection raised against it is the plain, bare-faced manner in which the earnings are regulated—a direct cut in prices when the workmen are earning what is considered an excessive amount. Of course, it is human to resist such reductions; but we have yet to hear of the system under which the workmen's compensation will not be subject to revision. There is no man living who can always correctly estimate the price or time for every operation, particularly on new work. It is not necessary that he should, so long as the workmen have sufficient confidence in the employer's justice to know that he will treat them fairly. I have frequently known men voluntarily to suggest reductions in prices which they considered too high. They did not do it through the expectation of any favors, but from the knowledge of the fact that if the prices had been too low they would only have to prove them so and they would be raised without hesitation. When this confidence exists, piece work in any reasonable form will be successful. After all, it is not so much the system that counts as it is the men behind it. The direct open cut is, in my opinion, a commendable feature rather than otherwise, because frankness, above all things, is necessary in dealing with workmen. If you have a proposition to make to them, first satisfy yourself that it is fair; then offer it in a straightforward, manly way and in a clear and comprehensive manner. Practice no deception in order to gain a point, because they are very quick to detect the "colored gentleman" in any "wood pile" in which they are interested.

While employers in general aim to treat their help justly, it is unfortunately true that they do not always succeed. The workman is not alone to blame for all the troubles that arise. I have frequently noticed cases of gross injustice as the result of what we might term long-range management, when the systems of remuneration are left in the hands of petty officials without knowledge of shop practice or the

whims of workmen, but with any amount of superciliousness and the greatest contempt for men in overalls. To this cause can be traced very much of the objection to piece work. Under such circumstances we generally find all the men employed on a certain class of work earning practically a uniform rate of wages. They are permitted to earn a certain percentage over their regular day rate; just as soon as they go above that they will be cut, and they know it; consequently, through compassion for their weakest shopmate, if for nothing else, they will hang back within the limit. If those in charge of such matters would take this into consideration, exercise better judgment, and allow men to earn a profit according to their productive ability, there would be much less trouble with piece work. By holding them down to a uniform rate and not permitting the best men to earn more than the worst, a condition is produced practically identical with that demanded by some of the unions, viz., a uniform day rate.

Another cause of trouble, also, is incivility on the part of those who deal directly with workmen. There is no reason on earth why a workman should not receive a civil answer to a civil question. This might be considered a small matter, but it is a source of irritation, nevertheless. I have also seen men in a factory defrauded of their wages on the merest technicality—wages earned under the most trying circumstances. Of course cases of this kind are extremely rare, but they certainly create a bad impression whenever and wherever they occur. We find cases also where, through fear of strikes and labor troubles generally, employers submit to all sorts of abuses from their help. The snail-like movements of the workmen usually indicate such a condition. Speeds and feeds are of the lowest. If on piece work, they generally get the price they ask for. When they want a day off, they take it without notice to their foreman. The employer who tolerates such a condition through fear is in reality spoiling his help and encouraging the conflict he wishes to avoid, because, sooner or later, competition will compel him to adopt different methods. The workmen may think that such a state of affairs is to their benefit, but in this they are mistaken, for the reason that it is unjust, if for no other, and consequently detrimental to all concerned. I have also seen men occupying the highest positions fomenting discord and trouble among the workmen in order to gain some advantage over a brother official with whom they are in dispute. Such men are a curse to any institution in which they may be placed. All quarrels among officials should be settled in the office and not carried into the shops. Troubles of this kind among officials usually arise through unwarranted interference, and

managers should have sufficient strength of character to control them. There is no place on earth where the ability to mind one's own business is more desirable than in the organization of a modern factory.

Workmen are to a certain extent what employers make them. Petty injustice, bad example, and weak management are responsible for much of the enmity that exists between employer and employees. It is the duty of capital, in its own interest, to enlighten labor and thus remove many wrong impressions from its mind. I am pleased to notice that a step in this direction has been taken by Mr. W. B. Pearson, of Chicago,* and it is one that should be followed up by others. But what is more to the point, information of that kind should form the subject of considerable discussion in the meetings of organized labor. If workmen were more familiar with business methods they would be in a better position to realize why their demands cannot always be granted. If the employer who considers himself right in his own views and contentions on account of his superior intelligence would only take the trouble to enlighten his help on the methods, risks, trials, and troubles of conducting a successful business generally, they might see things in the same light as he does. If enlightenment is beneficial to him, it should be equally so to them. The solution of the so-called labor problem is simply one of education—an education by which a knowledge of, and respect for, the rights of other men is obtained. Clear open-handed justice and plain straightforward dealing are the principles that should be followed in managing help. No quibbling, no underhand business of any kind. Meet them face to face without fear, and treat them justly. If this course fails, fight them with all the power at your command.

Workmen should understand that there are two sides to the questions in which they are interested as well as there are to all others, and that their side is no more likely to be right than their employers'. There should be no antagonism on principle, because the workman is less liable to be in possession of all the facts controlling the question at issue than his employer.

While in conversation with me, a labor leader cited in support of the machinists' union the extraordinary wages received by the locomotive engineers. He seemed to attribute this to the mere fact of

* The reference is to an admirable pamphlet entitled "Where Does the Money Go?" giving, for the instruction of the workman, a clear synopsis of the total expense of manufacturing, including all the non-productive elements usually ignored by the labour advocates. Its purpose is to dispel the fallacy that the employers' whole outlay is included in the items "labour and materials." The booklet is deserving of the widest distribution. We believe that those who are interested can secure copies from the National Metal-Trades Association, 95 Liberty street, New York.

organization. He did not seem to recognize the fact that a large number of the machinists object to running machine tools at the feeds and speeds which the manufacturer considers necessary to realize a fair return for his investment in the machines. Who ever heard of an engineer deliberately reducing the speed of his engine below the rate at which the railroad company decided it should be run? On the contrary, they accept the speeds cut out for them, and instead of reducing the efficiency of their machines, under the mistaken notion that it will afford employment to a greater number, with their life in their hand they push them up to the prescribed limit and take a pride in their performance. Such men, in my opinion, richly deserve every dollar they receive. I will admit that organization has contributed to their success, but it is organization of a kind which other unions might copy with profit. As stated in the June number of THE ENGINEERING MAGAZINE all mechanical development is toward an intensified production, because the wants of civilization demand it, and every obstruction which we place in the path of that development only adds to our burdens unnecessarily. We should not antagonize honorable means or methods by which production is intensified, because, on the whole, it is for man's benefit. We notice this in the continual shortening of the hours of labor. Do not think for a moment that the blessing of shorter hours is the result of organized labor's demands only—not by any means. The prime factor in its realization is the use which has been made of labor-saving machines and methods in promoting and reducing the cost of production. Brains came to the relief of muscle, and will continue to do so; therefore it is detrimental to the interest of labor to discourage or prohibit the use of such improvements. It was the free, active mind, and the big, generous day's work of the American mechanic that has secured the present commercial supremacy of the United States. For this he has received the highest compensation ever paid for like services anywhere, and he must continue to receive it so long as he maintains his superior productive capacity. It is the duty of manufacturers, as a body, to see that there are no unjust restrictions placed on the ambitions of workmen, even though it be only to increase their earnings through the medium of a large day's work. It is to the brain and brawn of the manufacturing industries that we must look for support in our efforts to keep in the front rank of civilization.

THE APPLICATION OF WATER-TUBE STEAM GENERATORS FOR NAVAL SERVICE.

By B. H. Thwaite.

ALL the great powers are rivalling each other in their designs and efforts to obtain additional colonising territory, to expand their empire, not only for the purpose of providing areas for the emigration of their people, but in most instances to provide close preserves for their trade and commerce. The effect of this 20th century desire for imperial expansion, upon the character of the defensive and offensive equipment, is indeed revolutionary. Each of the great colonising powers will secure battle-ships of the maximum speed and power, for the greatest distances. Therefore, the question of the most efficient steam generator is of paramount importance, and this supreme position has in quite recent years been more fully recognised by engineers.

Formerly the steam boiler never received the serious consideration of scientific students, most, if not all, the attention being devoted to the improvement and investigation of the steam engine. The result of this neglect is, that at the expiration of more than a century from the birth of the steam engine, there is a most striking difference of opinion amongst engineers upon the respective qualifications of the water-tube steam generator and the shell or cylindrical steam generator; one group of opinions holding that the latter type is alone worthy of confidence for naval work, whilst the other group considers that some one of the various forms of the water-tube boiler contains all the qualifications to satisfy the exigencies of naval engagement.

Another result of a want of the absence of knowledge of all the subjects that bear upon the correct design of a steam generator, and one that is ever associated with ignorance, is the fact that an innovation in established procedure or design is prevented from lack of confidence. This want of confidence has given birth to the principle of the policy of follow-my-leader, which has been adopted by most of the naval powers. Of all these France, and in a less degree the United States, deserve the praise that should be unstintingly given

The introduction of steam at sea has imposed two great problems—one the reorganisation of the *personnel* directing and fighting the ship, the other the perfection of economy and convenience in the great central source of power. This second and purely mechanical question will be thoroughly investigated by Mr. Thwaite in this issue of the magazine and the number for November following.—THE EDITORS.

to any nation that adopts the brave part of pioneer of new developments in structural science applied to battle-ship construction.

In the work of pioneering the British admiralty has hitherto notoriously lagged in the rear, and its only claim to recognition is the fact that it is of all the powers the most generously endowed with purchasing power by a sadly non-reflecting people.

The requirements of the navy are quite distinct from those of the mercantile marine, in which a vessel leaves one port for another at a uniform speed, and is rarely, if ever, called upon to increase her speed suddenly to the maximum possible.

The highest naval authorities have laid down certain inexorable conditions, and these conditions are such as to differentiate the naval steam generator from that of the mercantile marine. These are:

First.—Must be able to drop down from full high speed to dead slow, and vice versa.

Second.—Must provide a high evaporative potential along with a low weight of structure, and these qualifications must be associated with a satisfactory factor of heat utilisation in power development.

Third.—In the fullest speed periods, no smoke that will serve as an object of discovery for the enemy shall issue from the funnels.

Fourth.—The boiler must be compact as possible, occupying the least possible cubic space. Full pressure steam must be raised from the cold in one hour.

Fifth.—All the conditions specified must be secured without involving any risk or danger that might disturb the confidence of the firemen and supervising staff.

The explanation offered by a former official of the British Admiralty for the adoption of the water-tube boiler in place of the shell or Scotch cylindrical generator is as follows: In the plans of the battle-ships, submitted to the British Board of Admiralty in 1891, shell marine boilers were proposed. The board was informed that 12 hours would be required to get up steam under stress, but that it would not be advisable to press the boilers, and that if the safety and durability be considered, even 24 hours would not be too much. The explanation preferred was that the abnormally thick plates of shell boilers necessary to permit the high steam pressures to be established, made it dangerous to press the fires to raise steam quickly, owing to the varying degrees of expansion set up and the serious strains associated with them. The manœuvring disadvantages that the slowness of getting up steam involves decided the British Board of Ad-

miralty to adopt the water-tube boiler of the Belleville type; the decision appears to have been rather abruptly taken, and a very handsome sum was paid to M. Belleville for the right to use his patents. Lord Spencer, a prominent Liberal peer, being at the time head of the Admiralty Board.

It is notorious that in peace time the nerves of the men are disturbed by the unexpected giving way of a boiler or its steam pipe joint. What, therefore, would be the effect in time of war?*

The fact of slow steaming associated with the use of shell boilers is undoubted, and it is a consequence of one of its advantages, that is, its great reserve or potential of evaporative power, owing to the considerable weight of water it contains.†

Of course, in a naval engagement, the piercing of the shell of this type of boiler may release such an enormous accumulation of energy as to involve the entire destruction of the vessel.

In the opinion of the author, and his opinion is shared by those who have thoroughly investigated the thermo-physical effects brought into play by the shell boiler, the water-tube boiler now occupies an assured position as part of the evolution of steam-power thermodynamics, and will displace for naval purposes, in one or other of its types, the shell boiler, a product of irrational conservatism in engineering structural design.

Unfortunately the discussion of the merits and demerits of the two types of steam generators has been astoundingly clouded by the blinding influence of prejudice. The author has, therefore, tabulated as fully as possible the pros and cons of both classes.

SHELL STEAM GENERATOR.	THE WATER-TUBE STEAM GENERATOR.
Pro.	*Pro.*
1.—If a flame tube leaks it can be plugged; there is no necessity to draw the fires.	1.—Steam far more quickly raised from the time the fire is lighted in the grate, 40 to 60 minutes sufficing.

* The author has had a personal experience of the complete demoralisation of a torpedo-boat boiler-room staff by the unexpected blowing out of a flange joint in a locomotive type of boiler operating at a pressure of 200 lbs. The men completely lost their heads and tumbled over each other in their anxiety to reach the hatchway ladder.

† As an example of the seriousness of slow-steaming, without referring to the recent bad records of the British cruisers—the Terrible and other vessels—one can instance the incident reported in the Spanish war to the effect that 3 hours were lost by the Brooklyn, and 2 hours 40 minutes by the New York, at a most serious crisis in the naval engagement.

It is further reported that it was found to be most difficult, even with the application of the fire-banking principle, to keep up steam in all the boilers so as to be ready for action.

A partial exception was however found during the same war in the forced-draft boilers of the St. Louis and St. Paul; these two boats after banking their fires for some hours were able to raise the speed from low cruising degree of speed to that of 20 knots in 8 minutes.

SHELL BOILER. *Pro.*

2.—Less liability to danger through the introduction of saline feed water, lubricants or agents that initiate and sustain corrosive effects.

3.—Greater structural strength to sustain shocks that are inseparable from marine work. Also less liability to serious damage or by the ill-usage of stokers.

4.—The evaporative efficiency with moderate fire grate pressures is as good as can be obtained with the average water-tube boiler.

5.—Greater reserve of power owing to greater water space provided.

6.—With carefully banked fires a great potential of evaporative power can be obtained in half an hour.

7.—Sustained efficiency in long-distance trips, compared with the Belleville type of generator; claims under this head can be justified, and with them others as important.

Con.

1.—Slowness in getting up steam from the cold.

2.—Imperfect and indefinite circulation.

3.—Unequal expansion and contraction of the metallic portion constituting the heating surface.

4.—Owing to the rigidity of structure, defects 2 and 3 involve sooner or later—owing to the stresses—if not actual rupture, serious and costly repairs.

5.—The repairs involve the employment of skilled boilermakers.

6.—The removal of a shell boiler involves the use of special lifting appliances and its transport is difficult and inconvenient.

7.—After the repairs have been effected, it is very rarely possible to secure with safety the original steam pressures.

8.—Greater weight of structural material in proportion to power output.

WATER-TUBE BOILER. *Pro.*

2.—Far greater power output in proportion to weight of boiler.

3.—Therefore higher speeds are obtainable.

4.—Easily transportable.

5.—More adaptable and accessible for repairs and renewals; no special lifting arrangements are required.

6.—Easily constructed.

7.—Less cubic space required.

8.—Can be more or less readily inspected and cleaned.

9.—Circulation more or less definite and continuous, and improves with the increase of rate of combustion.

10.—More or less adequate provision made for the effects of expansion and contraction.

11.—Greater safety. No danger of the vessel being wrecked by explosion.

12.—No necessity for reduction of working pressure when an old tube is replaced by a new one.

13.—More or less easily accessible for inspection and repair.

14.—As the heat of combustion is greatly reduced (when the gases reach the upper tube), the danger of these tubes being raised to a red heat, in the event of the tubes being momentarily denuded of water, (the effect of passage through rough seas) is less.

15.—The experience of the South American war demonstrates that the water-tube boiler gives advantages of great tactical importance.

Con.

1.—More difficult to maintain uniform steam pressures.

2.—Tendency of the lime and magnesian salts to deposit in the boiler.

3.—The reduction and evaporative efficiency of the generator tubes by incrustation and the tendency to become dangerously overheated.

4.—Difficult during working operations to ascertain condition of tubes.

SHELL BOILER. *Con.*

9.—Cubic displacement in proportion to evaporation potential is greater.

10.—Necessity of reliance in the character of the structural metal employed is much greater than in a water-tube boiler.

11.—The considerable storage of evaporation potential provided by the water carried may in case of accident actually sink the vessel.

12.—It is necessary when high steam pressures are required to use very heavy shell plates 1¼ to 1½ inches thick, a condition fatal to uniform expansion and, *per contra*, contraction effect.

13.—When forced draft is employed with closed stoke-hole the effect of the admission of this air when the fuel is being fed upon the furnace crown is most serious.

14.—The same effect, forced blast, is liable to produce the bulging of the fire-boxes, owing to vivid combustion being prolonged through the tubes to the box.

15.—The tubular part of boiler is practically inaccessible, and this part is the *locale* of the greatest accumulation of deposits, and thorough cleaning is also impossible.

16.—Owing to the small grate-surface ratio to floor space occupied dangerous degrees of forced draft are unavoidable.

17.—The dangerous possibility that the flames may reach the upper tubes which may, owing to neglect and during the passage through a rough sea, be uncovered with water.

WATER-TUBE BOILER. *Con.*

5.—Any damage done to a single tube involves the drawing of the fires and the emptying of the boiler. Tendency to steam escape owing to the composite character and numerous points of the structure.

6.—Composite character of structure less suitable for the shocks inseparable from marine work.

7.—Great number of constructional joints.

8.—Greater attention required in supervision.

The following properties may be considered essential in a satisfactory marine steam generator for naval service:

First.—That there shall be perfect combustion of the fuel at all rates of grate combustion and without involving the production of a smoke trail that will be a dangerous signal to the enemy.

Second.—That the transmission of the heat produced in the water to be evaporated shall be as complete as practicable, and be either so well distributed, or the water circulation so perfect, that no dangerous expansion or contraction effects shall be produced.

Third.—That all associated chemical, thermal, or physical effects that tend to deteriorate the stability shall be reduced to a minimum.

Fourth.—That the steam generated as it leaves the stop-valve shall not carry more than a negligible proportion of suspended moisture.

The perfect combustion of the fuel is dependent upon the proper supply of air. With bituminous coal, such as is used in the furnaces of marine boilers, the proper supply of air varies according to the proportion of volatile hydrocarbon present. When the fuel consists wholly of fixed carbon, all that is required is to provide a sufficient weight of air to oxidise the carbon either to carbon monoxide, adding a secondary supply of air over the grate and fuel-bed to oxidise this carbon monoxide to carbon dioxide; or—the alternative—to supply a sufficient weight of air, employing a thin bed of fuel, to oxidise the fuel thoroughly and directly to carbon dioxide.

In the case of bituminous coal these direct operations are not practicable, and a certain amount of finely divided carbon is deposited as soot, which must be re-oxidised in a suitable combustion chamber, sufficient air being admitted for the purpose. If the hydrocarbons are brought into contact with the water-surrounded heating surface of the boiler before a full adequate supply of air permits their being completely oxidised, dissociation takes place, with the production of smoke. When the volume of air required to oxidise the fuel burnt at ordinary rate of combustion is realised, there will be no more designs with insufficient combustion space over the grate, and there will always be provided a secondary and well-distributed air supply over the surface of the fuel on the grate. Although the water-tube boiler offers opportunity for correct design in this respect, inadequate combustion space and imperfect air-supply arrangements are striking defects in most of the various forms of water-tube boilers.

In the case of the shell boiler, with its internal furnaces, there is a structural limit to the cubic space available for the initial combustion, and the satisfactory application of a secondary supply of air is most difficult. The cubic space through which the gases of combustion have to flow is greater than that of some water-tube boilers, and hence for moderate fire-grate pressures the evaporative efficiency is as high as in those water-tube boilers which have an inadequate combustion space.

It should be considered an axiom of perfect steam-generator design to provide a cubic space in the combustion zone equal to the maximum demands; if these are satisfied the space provided will be found satisfactory for the lesser air pressures.

The tactical dangers of imperfect combustion and its resultant smoke were strongly illustrated in this year's British naval manœuvres. The battle-ship Ariadne, equipped with Belleville boilers of the non-economiser type, proved to be a veritable coal eater; her empty bunkers compelled the rest of the fleet to risk a dangerous action in order that she might have her coal supply replenished, and from her funnels there issued, it is reported, a long trail of dense smoke that would have been easily observable by the enemy miles away.

An example of the ruinous cost of imperfect combustion is seen in the voyage of the Europa from Europe to Sydney, Australia. The vessel is equipped with Belleville boilers and with high-class engines, yet the fuel consumption attained the figure of 5 pounds of coal per horse-power hour. The total cost on this trip over what would have been required with perfect combustion is placed at £20,000.

All water-tube steam generators possess in a lesser or greater degree of perfection the feature of definite circulation. This characteristic differentiates them from any existing type of marine steam generator. Of course, even with this valuable quality, the structural arrangements may be so bad as almost to nullify the advantages.

It is obvious that the frictional resistance to the flow of water is less in straight than in curved tubes, and that abrupt diversions seriously reduce the momentum and tend to produce eddies which seriously retard the rate of flow and tend to produce the deposition of suspended matters it is the object of circulation to avoid.

If heat can be equally as well applied to a vertical as to a horizontal tube, the more nearly vertical the tube the better; in practice the application is difficult, and the solution is found in the inclination of the tubes, the angle of inclination varying greatly in different water-tube boilers. Associated with this problem is another—to secure the form and direction of tube that will provide the greatest separation of steam. Further, there is the tendency to form steam spaces in the tubes. When a tube is abruptly curved, or is too horizontal, if exposed to the hottest zone of the furnace these steam spaces may be produced, and immediately the tube becomes raised to a critical temperature dangerous oxidation may be set up. See remarks on oxidation. A well-designed arrangement of circulation will prevent these dangerous points of steam formation.

In designing circulating arrangements the following precautions may be remembered:

a. Let the tubes be as direct as possible.

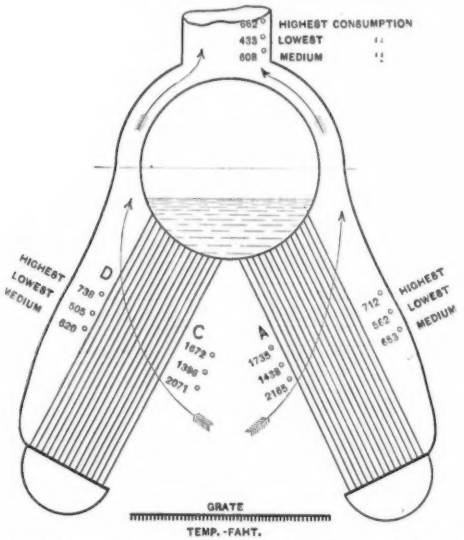
b. Avoid abrupt bends; let the curves, if their use is inevitable, be of as large a radius as practicable.

c. The direction of the tubes (and this applies more directly to the part exposed to the most intense zone of heat) should be as nearly vertical as practicable.

d. The return water tubes or tube down-comers should have an adequate area, so as to assist rather than retard circulation.

The escape of steam bubbles, when formed, is assisted by the vertical direction of tubes, but is seriously retarded by horizontal ones, and especially those having abrupt bends. Of course the evils of the latter conditions will be greatly aggravated if the tubes are small.

FIG. 1 – SHOWS THE TEMPERATURES OF COMBUSTION DEVELOPED IN A YARROW TYPE OF WATER TUBE SG.



The degree of heat transmission is a function of the velocity of the heat absorbing liquid. With water, according to Sez (*Traité de Physique Industrielle*), the rate of transmission varies roughly from 1 to 5, the degree depending upon whether the water is quite stationary or in rapid motion; in other words, the transmission is 5 times greater if the water is flowing rapidly than if stationary.

Active circulation stimulates vaporisation.

The greater the velocity of circulation the greater the durability of the tubes.

The effects of expansion and contraction, so destructive to the shell type of steam generators applied in high-pressure marine engines,* are controllable in the well designed water-tube boiler.

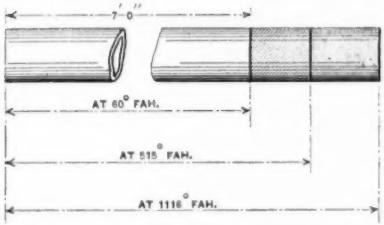


FIG. 2. SHOWS, FULL SIZE, THE EXPANSION OF A GENERATOR TUBE 7 FEET LONG, CONTAINING WATER AT 300 DEGREES F., AND HAVING A SURROUNDING HEAT OF 2,000 DEGREES F., AND THE SAME TUBE CONTAINING WATER AT 300 DEGREES F. WITH A SURROUNDING HEAT OF 730 DEGREES F.

It is self-evident that the degree of expansion is a function of temperature, and the uniformity of such temperature. Therefore, the more perfect the circulating arrangements, the greater the uniformity of temperature of the generator structure, and the less the expansion effect. If a tube is rigidly attached at one end only and is quite free to extend itself at the other, the expansional influence of heat is quite harmless. The evil is not always a consequence of expansion, but may be the result of the subsequent contraction effect.

Again, if a tube attached to rigid connections at both of its ends is sufficiently curved, the expansional effect is simply absorbed in increased curvature effect. Assuming that the connections to the rigid places are properly made, both methods of meeting expansional effects are satisfactory. It is strongly inadvisable to employ a screw-thread connection, because of its tendency to leak and the difficulty of removal. Either expanded or coned joints are to be preferred.

The question of durability, involving thicker tube sides, will affect somewhat the radii of the curves that can be employed.

The adequate compensation for the fresh water evaporated is more important for water-tube boilers than for the shell class, because the margin of safety is less, owing to the small weight of water stored in generator.

The importance of automatically maintaining a steady flow of fresh water to correspond with the proportion evaporated is well rec-

* According to *Engineering*, July 27, 1900, "The record of the Bellevilles is spotless white, compared to the history of the tank in the British Navy just previous to its suppression.

In the test of the Royal Sovereign—"after a three hours' test out of what should have been a four hours' run at full speed, the trial was stopped on account of the leaky tube ends."

ognized by the makers. Unfortunately some of the apparatus so far devised is more or less complicated, and is liable to become deranged by the influences of oxidation or corrosion.

In a well-designed and organised fleet it should never be necessary under any conditions to have to rely upon sea water. If this is inevitable, it would be better to provide a few shell boilers as auxiliaries, because this class of steam generators is rather more suitable for this character of feed. However, all the progressive admiralties, thanks to one of the serious lessons of the Spanish-American war, are becoming alive to the importance of providing for their fleets that are equipped with water-tube boilers, a sufficient number of vessels whose object is to distill sea water and provide an adequate supply of fresh water for every vessel in the fleet.

The great *bête noir* of boiler attendants is the incursion of sea water into the feed, owing to the defective tubular condensers. If the circulation is rapid, and the arrangements for effecting the separation of sediment are satisfactory, this impurity will not prevent the water-tube boilers from being worked for some considerable time, although the increased tendency to prime caused by the introduction of sea water will involve extra attention.

If the fresh water contains lime or magnesia, these impurities will have a tendency to deposit from hot water on surfaces where the water is stationary. Here, again, the importance of rapid circulation cannot be exaggerated. It must be obvious that all sediment-depositing chambers should be placed external to the boilers and in readily accessible positions. Another undesirable intruder is the grease of lubricants from the motive-power machinery, introduced with the condensed water.

With a water circulation of sufficient velocity, assuming that the density has not been allowed, by neglect, to become too great, it is impossible for the impurities to deposit. The scouring or erosive action of the water in the tube sides will prevent this. It is, of course obvious that there will be more erosive action on the surfaces of a small tube than on a large one, in the direct proportion to the ratio of the cross-sectional area to the internal circumference.

The convenience of internal and external approach should be one of the advantages of an ideally-designed water-tube boiler. In this respect it has intrinsically an advantage over the shell type. In several of the designs this advantage has been neglected. In the shell boiler it is practically impossible to obtain access to the interior part in which the nest of tubes is located. This is self-evident by examination of

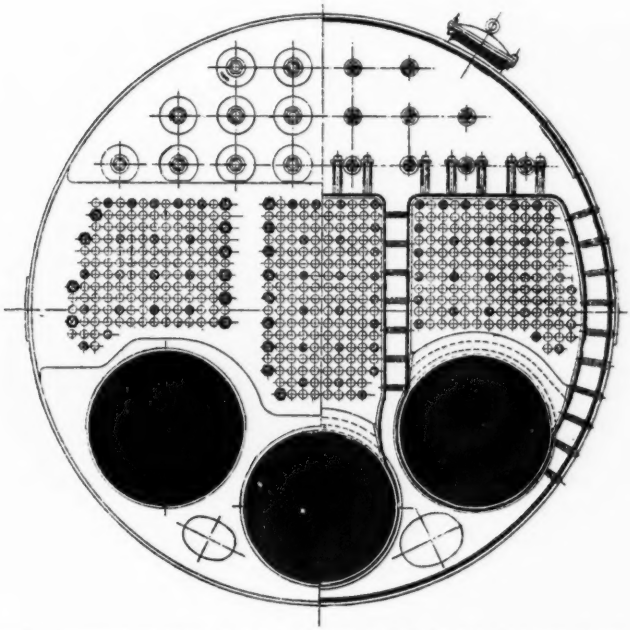


FIG. 3. SECTION OF SHELL BOILER, CHINESE WAR-SHIPS HAI TIEN AND HI CHI.

Fig. 3, representing a section of the shell boiler of the Chinese war ships Hai Tien and Hi Chi.

The inside of every tube should be accessible for examination, and all the accessory vessels should be also and conveniently approached, internally and externally.

It should be possible readily to remove and renew a tube. Of course, in a nest of small tubes, if the defective tube is in the middle of the nest, it may be necessary to remove all the tubes between it and the outsides; but if time is urgent, the tube should be accessible to temporary closing with a plug. Removable casings should be provided to permit the immediate examination of the nest of tubes, and the casings should be well and stiffly, but not too heavily, constructed, and none of their rivetted seams should be exposed to the possibility of flame contact. This is important, because the warping of the casings provides apertures for the entrance of air that reduces the chimney draft and disturbs the combustion arrangements.

The question of durability has assumed a position of considerable

importance, because the spokesman for the British Admiralty, in his report to the British Parliament, stated that the small-tube type of water-tube boilers is not nearly so durable as the large-tube, and especially the Belleville type, the explanation being the fact that the tubes of the latter are thicker. But the remedy for this is simple. Let the sides of the small tubes be thickened. There is no insuperable difficulty in effecting this.

The influences that reduce the serviceable life of the water-tube boiler are those of internal and external corrosion and oxidation, and the rapid alternating effects of expansion and contraction, and to a very inappreciable extent, the erosive influences of the rapid currents of water. See Fig. 4, shewing the burst tube taken from a Belleville steam generator of the Orlando.

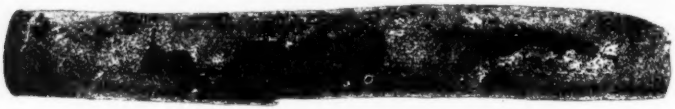


FIG. 4. BURST TUBE FROM BELLEVILLE BOILER ON THE ORLANDO.

The effect of corrosives in reducing the durability of shell boilers is well known. Fortunately, by the displacement of vegetable oil by that from mineral sources for all lubricating requirements, this organic agent, one of the greatest sources of this insidious but destructive action, has been removed, but corrosive effects do still occur, their origin being traced to the inclusion of air in the boiler, and the effect of moisture. The water-tube boiler has here again advantages over the shell type. Rapid circulation will remove the source of the trouble from its *locale* of action. The proportion of air that can be enclosed in a water-tube boiler will be less than that in a shell type. Air is always present in fresh feed water, and when the boilers are empty the space is air filled.

Experiments have proved that corrosion is promoted by contact with a combination of air and moisture, the effect being greater in proportion to the weight of carbon dioxide existing in the air. The exclusion of the air, therefore, removes two of the active agents. The water feed tanks supplying the feed pumps should never be allowed to become empty, because this would incur the sucking of air and its introduction into the boilers.

The greatest protection should be given to water-tube boilers when a naval vessel is not on active service. When a vessel is ordered out for active service her water-tube boilers should be given a dose of

lime, say 8 pounds of lime to every thousand horse power, added to feed tank. This agent will neutralise the influence of any enclosed air on the water-covered surfaces, and if there is leakage of sea water into the feed, ordinary lime of commerce, unslaked, should be daily added in proportion of 1 pound to every thousand indicated horse power of the boilers.

Rolled zinc blocks placed in metallic contact with the metal to be preserved can be placed in the steam and water drums with advantage. Quick lime should be placed in the boiler, when not at work, to absorb the moisture, and the boiler should then be made air-tight. Baskets containing coke fires can be placed inside the generators. The CO and CO_2 produced by the combustion of the coke will drive out the air; the manholes should then be carefully fastened up.

The metallic surfaces that are exposed to steam and water intermittently are more seriously influenced by corrosion than the surfaces continuously exposed to either water or steam. When this surface is of a tubular form, one remedy is to galvanize the tubes internally; and this protective process is becoming popular for all kinds of tubes, large and small, that are used on water-tube boilers.

The efficiency of the water-tube boiler depends very greatly upon the character of the labour and supervision of the firemen. Therefore, the health conditions of the work should be considered, and more especially in water-tube generators. Where a pair of boilers are placed with their fire-doors opposite each other, the stoke-holes in the hot days of summer or in tropical climates become perfect infernos. The author suggests that, wherever possible, a wall of small tubes should divide the stoke-hole or form one of its sides, and through these tubes sea water should be constantly pumped. Such a system would interfere with closed-stoke-hole arrangements, but would make the conditions of the fireman's life so satisfactory that there need be no neglect of his duty to the boiler.

The importance of dry steam is pretty well acknowledged by boiler makers. It is far more difficult to generate dry steam in water-tube boilers than in the shell class, but by an ingenious arrangement of baffle-plates fixed in the steam drum, the suspended water is separated from the steam before the latter is allowed to flow to the engine.

So much suspicion has been created owing to the serious disparity between the working every-day service results and the test results of naval vessels, that some remarks upon the misleading character of short tests are necessary. An example is found in the trip recently made by the battleship Terrible (sister ship to the Powerful), from

Hong Kong to Taku. The service was of serious national importance, carrying troops to rescue the British in Pekin. The trip, a distance of some 1,800 miles, was effected in 5½ days, equivalent to a speed of only 13½ miles an hour, instead of the 22 miles' speed recorded in the short-period tests. The Terrible and the Powerful are supposed to indicate 25,000 horse-power.

The only tests of any system of power-production equipment that can be considered absolutely representative or reliable are those extending over a period of several days. It is astonishing that this obvious truism has not been practically acknowledged. It is the old story—no one cares to overcome the inertia of common practice. A test under ordinary working conditions, with a competent staff of firemen, would provide data that could not be disputed, and the inclusion of such a test in the contract specification would doubtless be accepted by all ship-builders. Such a test could be confined as far as the water-tube steam-generator efficiency is concerned to the ratio between the weight of fuel burnt at specified air pressures, and the water evaporated to a condition of dry steam measured from and at 212° Fahr., a specific weight of steam being allocated to produce a given indicated horse-power, say 17 pounds. The calorific value of the fuel should be tested by the Berthelot-Mahler calorimeter and the evaporation be reduced to a standard to be agreed upon of calorific value. The results of such a test would enable the character of the steam-generator system to be determined by the equation of efficiency.

It is obvious that if the weight of a boiler, *per se*, is low in proportion to its evaporative power, this factor is by itself a valuable index of character, but *only* when its degree of heat utilisation efficiency is also satisfactory, otherwise the weight of fuel to be carried for a given period of power development may destroy the low-weight advantages possessed by the boiler.

The proposed equation is as follows:

Let A be the weight of fuel burned per square foot of grate, corrected by calorimeter to a standard calorific value; B, the number of pounds of water evaporated into dry steam per pound of fuel burned per square foot of grate surface; W, the total weight of the steam generator; then will the

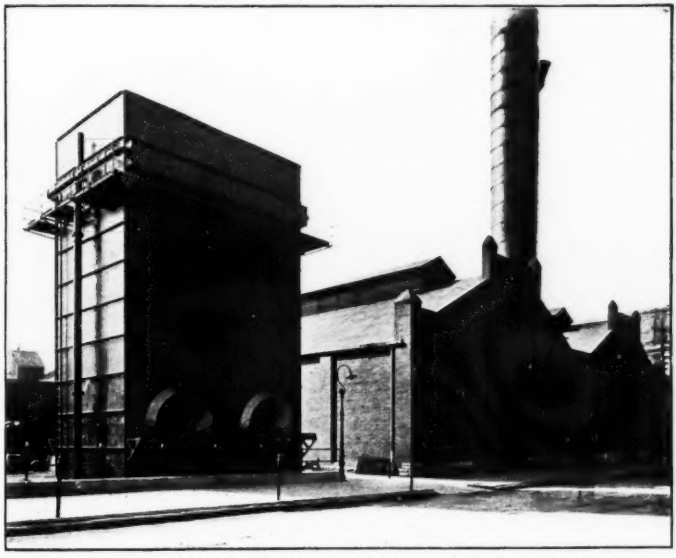
$$\text{Actual useful efficiency} = \frac{A \times B}{W}$$

The next article will discuss various representative types of water-tube boilers used in naval service.

THE CENTRALISATION OF THE STEAM-CONDENSING PLANT.*

By Harry G. V. Oldham.

BOTH in America and Germany the cooling tower has received considerable attention; improvement has been made in its design and it is now generally an efficient apparatus. The Worthington tower consists of a number of short pieces of earthenware pipes, standing upon one another so as to break joint and to form an irregular surface to split up the circulating water and expose it to the current of air passing through the apparatus. The circulating water is delivered through a pipe at the centre of the tower, and on



BARNARD WATER-COOLING TOWERS, EDISON ELECTRIC STATION, ST. LOUIS, MO.
Wheeler Condenser & Engineering Co.

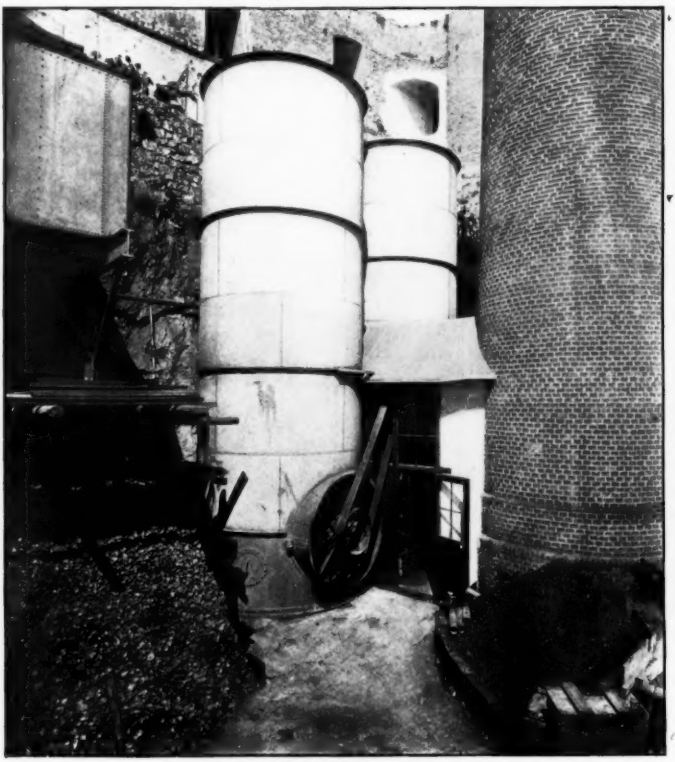
reaching the top flows into four branch pipes, from which it is sprayed over the top course of circular tiles or pipes. When reduction of weight is desired, these pipes are made of galvanized iron. The four-

* Mr. Oldham's first article on this topic appeared in THE ENGINEERING MAGAZINE for October, 1900.

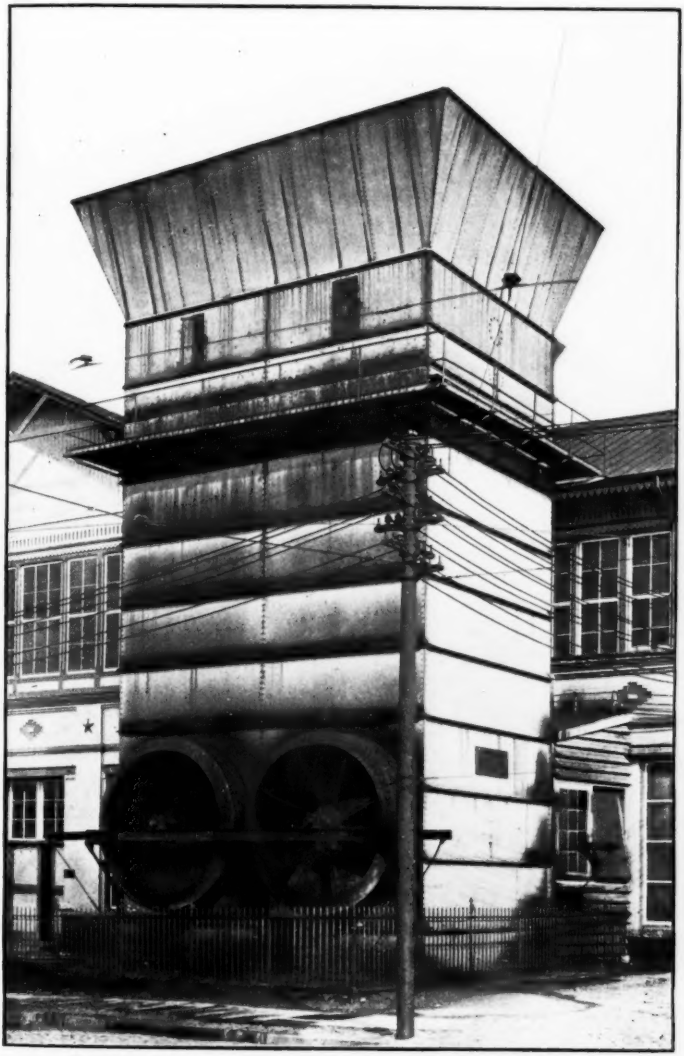
branch arm revolves on account of the impinging of the water against the enclosed air.

On the next page is shown the Barnard-Wheeler cooling tower. This apparatus contains a number of galvanized wire mats, which are hung upon hooks. These mats in some cases measure 12 feet by 16 feet, and in others 23 feet long, and are made of galvanized-steel meshed wire. The mats are hung vertically and placed closed together, so as to present a continuous surface to the circulating water and the passing air current and bring the two in close contact. On page 216 these mats are shown. Fans are used to supply the air current.

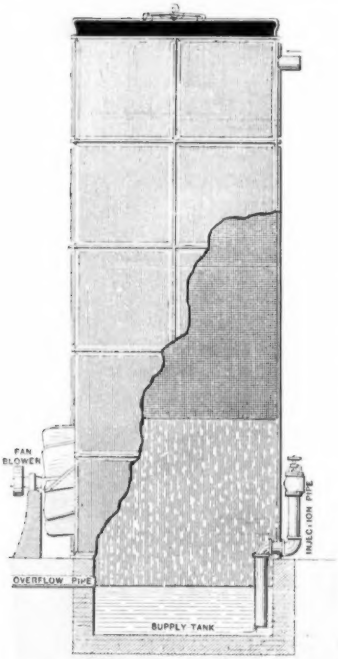
A Barnard-Wheeler tower capable of cooling the condensing water for a steam consumption of 40,000 pounds of steam per hour occupies



A WORTHINGTON WATER-COOLING PLANT.



BARNARD WATER-COOLING TOWER, 2,000 HORSE-POWER CAPACITY.
Operating at Hoboken, N. J. Wheeler Condenser & Engineering Co.



SECTION OF BARNARD-WHEELER TOWER, SHOWING ARRANGEMENT OF MATS.

a ground space about 12¼ feet by 12 feet, by about 36 feet high. Two 10-foot diameter fans at 130 revolutions are supplied with this tower, taking about 13 horse power to drive both.

In a plant now being erected at Islington the above firm are installing their fanless tower, capable of dealing with 40,000 pounds of steam per hour. The space occupied is somewhat greater, but as no fans are used the power that would be required to drive them is saved. This type is illustrated on page 219. The tower is open to the air on all sides, and the wire mats, which are hung vertically, radiate from the centre. The water is distributed over the mats from the top of the condenser by perforated and slotted pipes.

The Klein cooling tower is usually made without artificial draught, but where space is to be economised it is fitted with air propellers. The illustration on page 217 shows an underground cooler. The open-type Klein tower is rectangular in exterior form and contains a number of gates made of light woodwork. These are hung from each end, the next batch of gates below being hung at right angles to the ones above. The upper part of the gate forms a trough, catching the circulating water from the distributing trough, which then overflows and runs down the sides of the gate. At the lower end of the gate the water is caught by the angular points shown (which points are so arranged as to cause the water to fall directly over the trough on the lower gates), from which it overflows directly over the surface of the gate beneath.

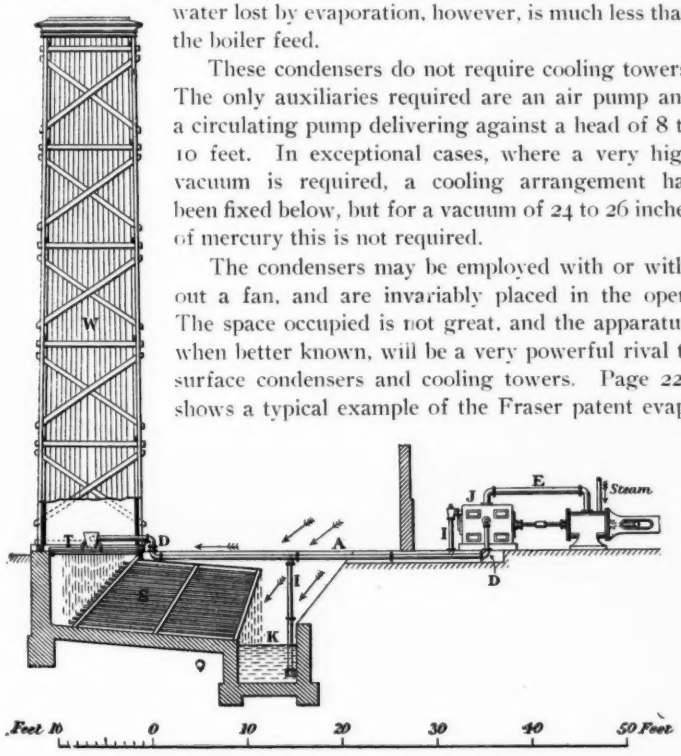
These towers are usually exposed and depend on the atmosphere to clear them of steam, but in some cases are enclosed, the air passing through them from the lowest part, as with chimney draught.

The illustration on page 218 shows an 800-horse-power Klein cooler.

The Evaporative Condenser.—It is perhaps desirable to explain briefly the principle of this type. The number of thermal units in one pound of steam at those pressures we have to deal with in the condenser are about 1,000 more than those contained in one pound of water at the same temperature. If, therefore, water be turned into steam under the same conditions, the latent heat (966.9 B. T. U.'s) passes from the steam to the water, converting the water into steam. This is exactly what happens in the evaporative condenser. The exhaust steam passes through on the inside of the tubes and the water flows on the outside, and the heat of the exhaust steam is transferred to the circulating water, evaporating a considerable portion of it. The water lost by evaporation, however, is much less than the boiler feed.

These condensers do not require cooling towers. The only auxiliaries required are an air pump and a circulating pump delivering against a head of 8 to 10 feet. In exceptional cases, where a very high vacuum is required, a cooling arrangement has been fixed below, but for a vacuum of 24 to 26 inches of mercury this is not required.

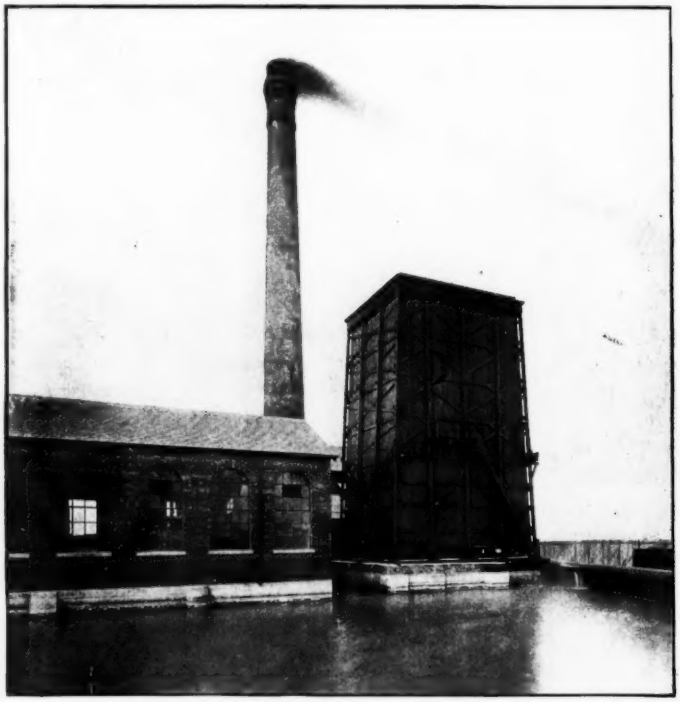
The condensers may be employed with or without a fan, and are invariably placed in the open. The space occupied is not great, and the apparatus, when better known, will be a very powerful rival to surface condensers and cooling towers. Page 220 shows a typical example of the Fraser patent evap-



JET CONDENSER AND UNDERGROUND KLEIN COOLER, WITH CHIMNEY DRAUGHT.

orative condenser, which is equal to dealing with about 200 indicated horse power. A plant recently erected by the same firm is now producing 24 inches vacuum under a load of 1,600 indicated horse power.

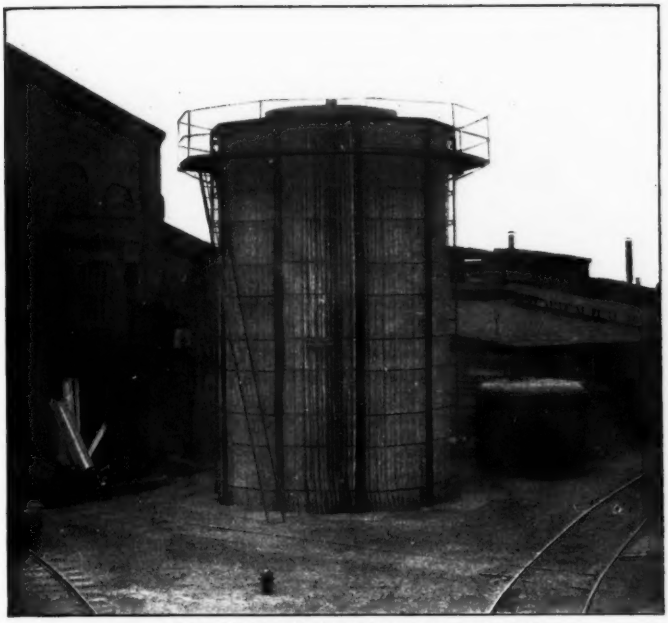
In this pattern of condensers the circulating water is delivered into the perforated pipes shewn, which are carried immediately above the top tube of each nest.



NATURAL-DRAUGHT CHIMNEY WATER COOLER, BLACKPOOL & FLEETWOOD TRAMROAD COMPANY S GENERATING STATION, BISPHAM.

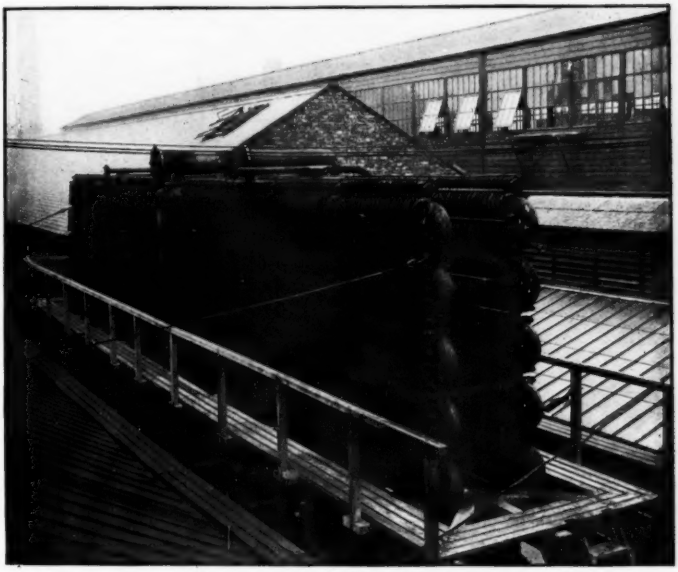
For cooling the condensation water from engines of 800 indicated horse power. Klein Engineering Co., Ltd.

The photograph on page 219 shews a Ledward patent evaporative condenser, now working at Messrs. Sir C. Furness Westgarth & Co.'s works at Middlesbrough; it is capable of dealing with 16,000 pounds of steam per hour, or 300 indicated horse power, and maintains a vacuum from 21 inches to 22 inches, according to the weather conditions. This is accomplished without any artificial draught.



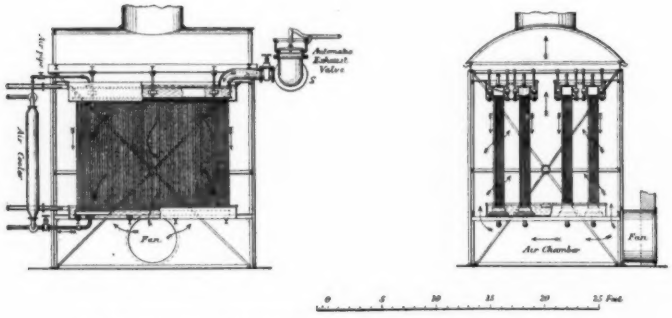
1,000 HORSE-POWER FANLESS WATER-COOLING TOWER

Wheeler Condenser & Engineering Co.



LEDWARD EVAPORATIVE CONDENSER. AT THE WORKS OF MESSRS. SIR C. FURNESS WESTGARTH & CO., MIDDLESBROUGH.

16,000 lbs. steam per hour; maintains a vacuum of 21 to 22 inches without any artificial draught.

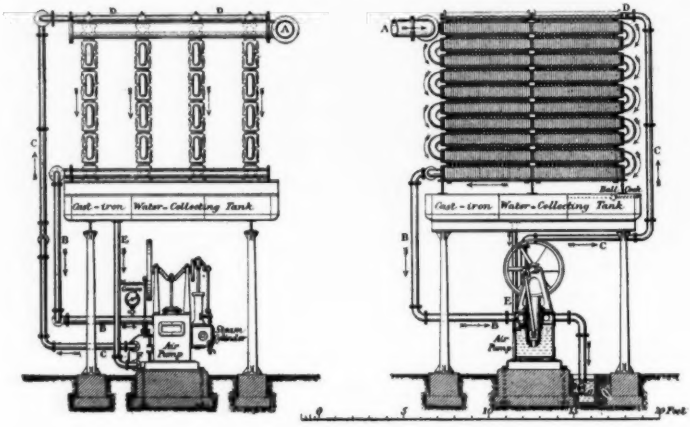


FRASER VERTICAL BRASS-TUBE TYPE OF EVAPORATIVE CONDENSER.

The engravings below shew more clearly the details of this type of condenser. The pumps are here shewn beneath the condenser, but may be placed in any convenient position. The condenser shewn is capable of dealing with about 150 indicated horse power.

It is always policy to design an apparatus so that it occupies a minimum of floor space, if this can be done without loss of economy in working. With this object in view an evaporative condenser with vertical brass tubes through which a fan was used to propel air was introduced by Thiesen in Great Britain.

Experiments have been made which shew that the condensation of steam is increased more than 50 per cent. by use of an artificial air



LEDWARD CAST-IRON CONDENSER, WITH AIR PUMP. 150 HORSE POWER.

current. How nearly this result can be approached in practice remains to be seen; undoubtedly in a carefully-designed brass-tube vertical condenser the value of a fan is considerable.

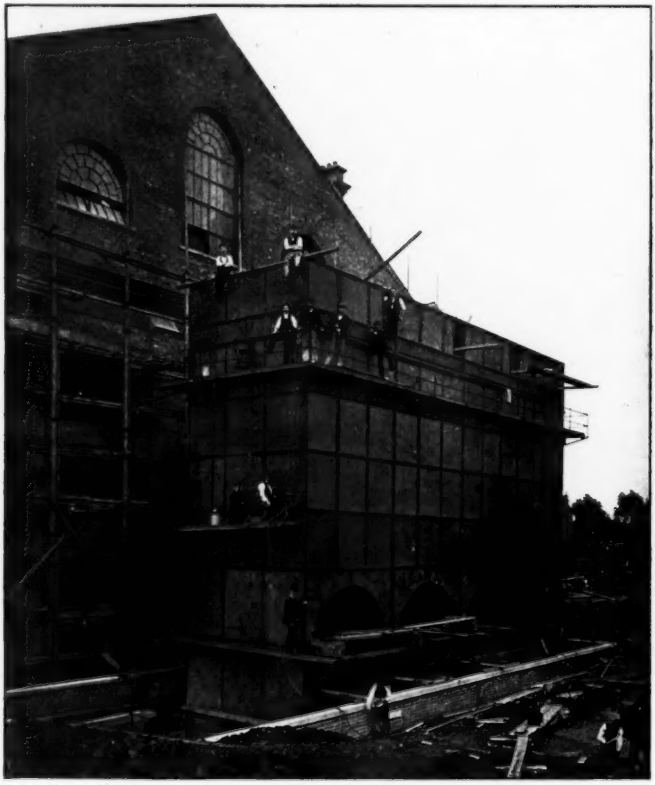
The illustrations opposite shew a section through a vertical brass-tube condenser which is representative of this type. The steam

3,000 HORSE-POWER BARNARD COOLING TOWERS, EDISON ELECTRIC STATION, N. Y.
Wheeler Condenser & Engineering Co.

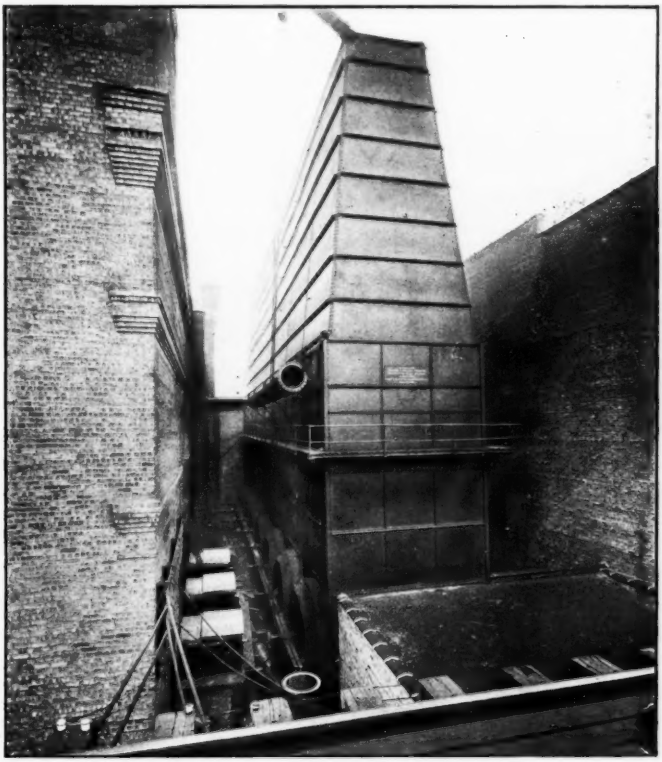
enters at the top and flows down the vertical tubes to the lower chamber, and is then, in the condensed form, drawn off by the air pump. The circulating water is pumped into the top tank and passes out by way of the annular spaces left between the tubes which pass through

the bottom of the tank and the edge of the larger holes through which they pass. This space, however, often got obstructed with dirt, stopping the circulation of some tubes altogether.

These tubes were from 10 to 12 feet long, and difficulty was experienced in getting the water to flow evenly down the tube. Some makers wound galvanised-iron wire helically around the tubes; others lapped the tubes with galvanised-wire netting, and in some cases cups were fixed on the tubes at equal distances, to catch the water and at intervals and so redistribute. Difficulty, however, was experienced with this type of condenser from the above fact, and also from the fact that the surface allowed— 10 square feet per 20 pounds of steam per



[BATTERY OF BARNARD COOLING TOWERS IN COURSE OF ERECTION, POWER STATION OF CENTRAL LONDON RAILWAY.
Wheeler Condenser & Engineering Co.



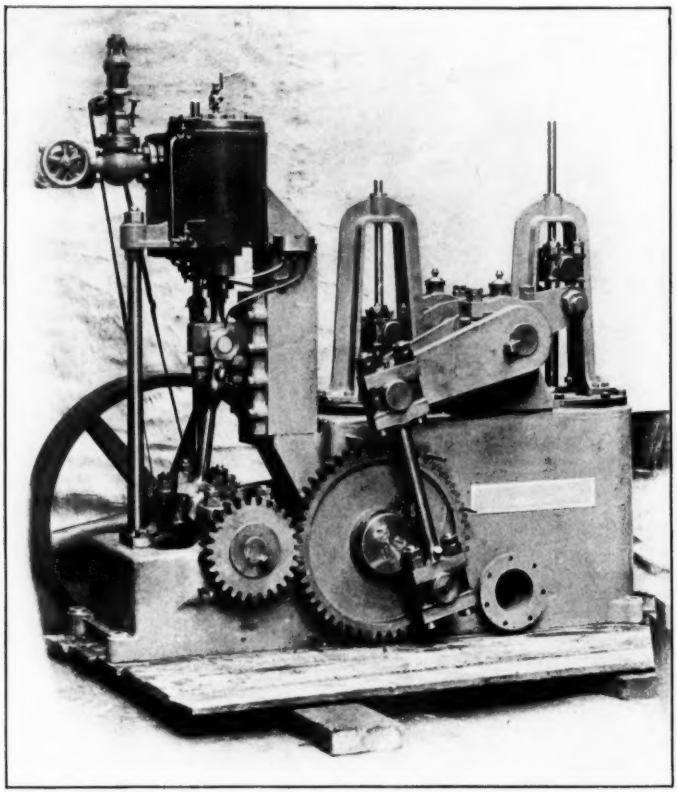
WATER COOLING TOWERS, CHICAGO, ILL. 12,000 HORSE POWER.

Wheeler Condenser & Engineering Co.

hour—was quite inadequate. The latest modern practice in evaporative condensing has evolved two types—the open horizontal-tube condenser, and the vertical type, as made by Messrs. Cooper & Greig, of Dundee. These condensers are undoubtedly giving good results.

No condensing plant can be successful unless an efficient air pump is provided. Considerable improvements have been made in this direction, and some of the leading pumps will be described. It may be mentioned that the single-acting pump with one barrel is practically discarded as regards modern condensing plants. The variation in the work upon the up and down stroke introduced conditions of wear and running that were not desirable for efficiency.

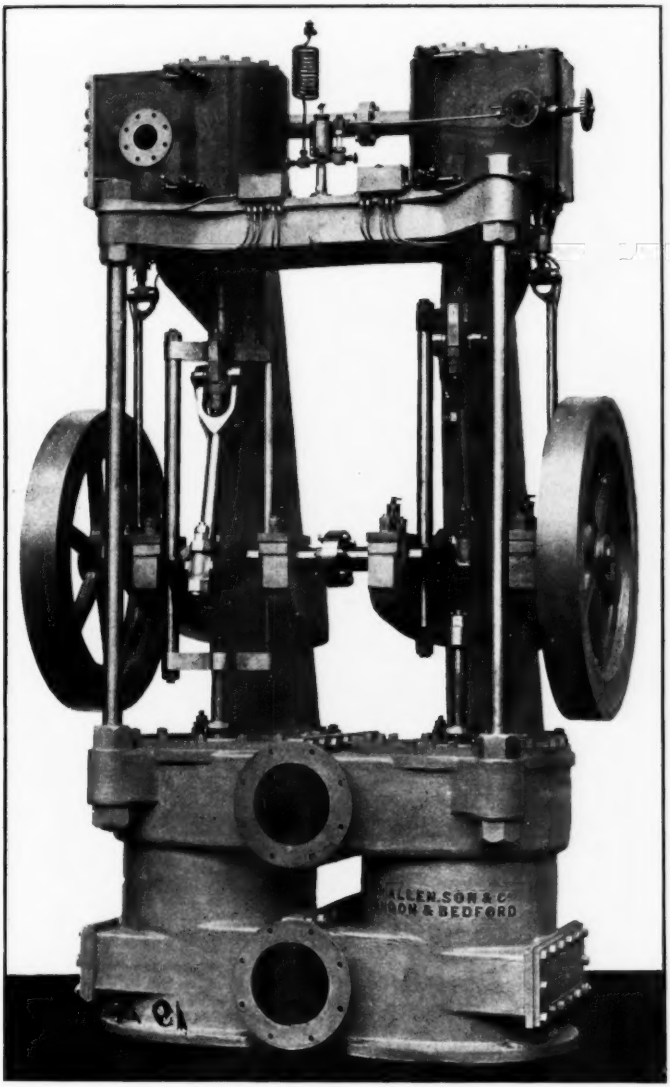
Air pumps connected directly to marine engines were necessarily of a large diameter, on account of the low velocity of the pump and bucket. It is now possible, with independently-driven air pumps, to reduce considerably these dimensions, by reason of the higher speed at which they may be run.



INDEPENDENT AIR PUMP, DRIVEN BY GEAR WHEELS AND A ROCKING SHAFT.

Messrs. John Fraser & Son.

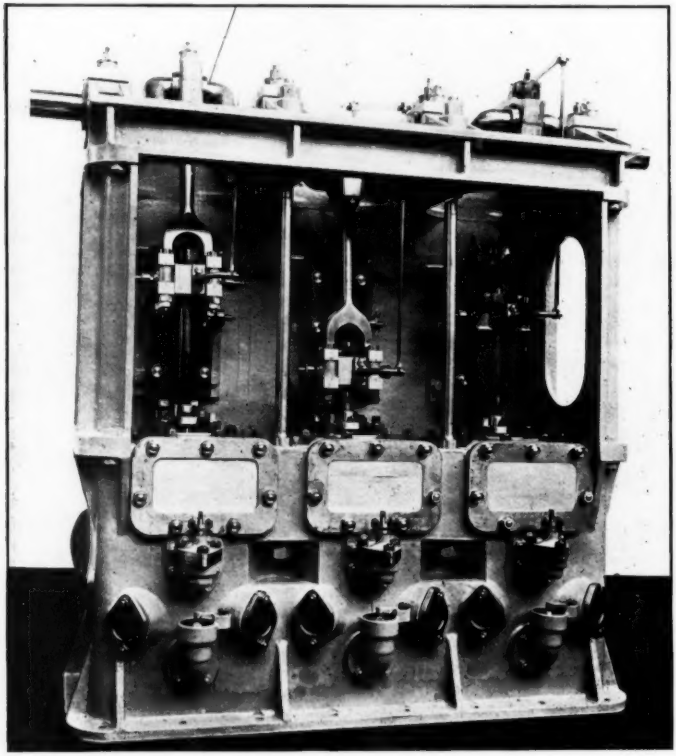
The general internal design of the air pump follows very closely that of the marine type, with sets of valves in the bucket and above and below the two extremities of the stroke. The modern air pump, however, has two or more cylinders, the buckets being driven by a rocking shaft and beam or by a 2- or 3-throw crank. An efficient air



AN INDEPENDENTLY-DRIVEN AIR PUMP.

Deals with 60,000 lbs. steam per hour; 9 and 15 by 14 inch engine, 25¼ by 14 twin air pumps, 90 revolutions per minute. W. H. Allen, Son & Co.

pump does away altogether with the bucket and foot valves, the only valves being those above the bucket. This type of pump admits of being run at a very much higher speed than the ordinary air pumps.



EDWARDS AIR PUMP IN CONNECTION WITH LEDWARD CONDENSER, KENSINGTON AND KNIGHTSBRIDGE ELECTRICAL SUPPLY COMPANY'S STATION.

Cylinders 12 by 12 inches; crank shaft directly-driven by 200-volt electric motor.

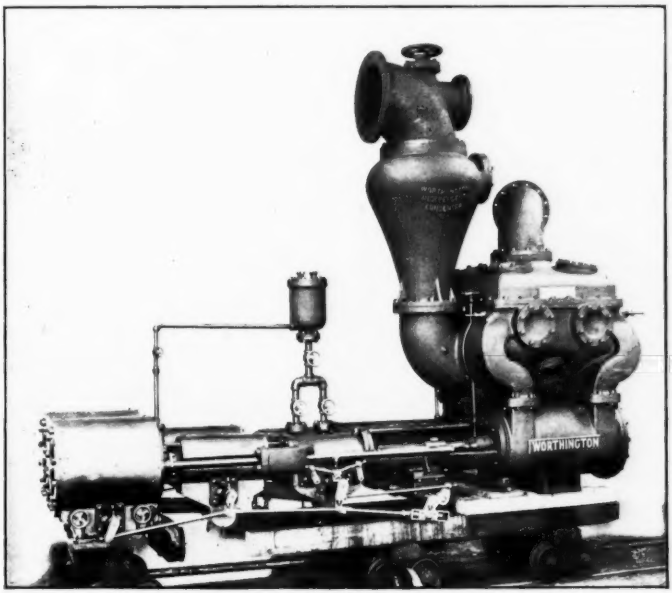
The twin air pumps shown on page 225 are by W. H. Allen & Co., of Bedford; they are capable of dealing with 60,000 pounds of steam per hour at 90 revolutions per minute. The air cylinders are 25 inches diameter by 14 inches stroke. The extreme height is 14 feet.

The type adopted by Messrs. John Fraser & Son, is shown on page 224. They are twin air pumps, steam-driven, and working through gear wheels to a rocking shaft.

The Edwards air pump shown on this page is working at the Ken-

sington and Knightsbridge Electrical Supply Co.'s Station in connection with a Ledward condenser. The cylinders are 12 inches diameter by 12 inches stroke. The crank shaft is driven directly by a series-wound 200 volt electric motor. The magnets are bolted to the pump casing, but are not here shown. On full load the power required to drive these pumps was 5 brake horse power, an extra 2½ brake horse power being required when the pumps were first started, for extracting the air from about 6 inches vacuum before starting the engines. The maximum load was over 20,000 pounds of steam per hour.

These pumps are run in some instances as high as 375 revolutions per minute, and in pumping works as low as 20 revolutions per minute. In the former case 28 inches of vacuum was obtained with a



HORIZONTAL-TYPE AIR PUMP FOR CONDENSING PLANT.

Worthington Pumping Engine Co.

feed temperature of 107 degrees F. and the barometer standing at 30.45 inches.

The pump on this page is a Worthington air pump of the horizontal type; it is steam driven. A vertical beam type is made by the same company. The pumps described are those now generally adopted

for all types of condensing plants, and are all working in various stations and manufactories where condensers are used, as well as on shipboard.

It should not be forgotten, in regard to air pumps, that the height to which the water is raised should be as small as possible—not more than a few feet at most above the discharge valves, as this head compresses the air in the air pump. The most efficient method is to allow only 6 inches to lie above the valves—just sufficient to seal the valves effectually. To effect this an outlet is placed 6 inches above the discharge valves, the water being delivered to an adjoining tank, from which it is removed by a small plunger pump.

Oil Separators.—It is well known that oil causes mischief when allowed to pass into a steam boiler. Therefore care should be taken that adequate means are used to separate this oil from the exhaust steam. It is undoubtedly the right plan to perform this operation before the steam enters the condenser. Various methods are used to filter the feed water after it has passed through the condenser, but all depend more or less on some fibrous material or fine shavings and sawdust, through which the feed water has to be forced. When the filtering material is choked with oil it is removed and replaced, or in some cases renewed. But, as mentioned, a separator that deals with the oil before it enters the condenser is preferred. The essential points in such a separator are that it should be of ample capacity compared with the area of the exhaust pipe. The exhaust steam on entering this separator chamber expands, with a reduction in velocity, and throws down the oil held in suspension. What is not deposited in this way is caught by baffles suitably arranged on the inside.

A good method to drain this apparatus when it is a suitable height above the floor line is to carry a small pipe from the under side to a catch tank about 30 feet below the condensers; the oil then drains naturally into this tank, from which it can be pumped, and, when strained, used again. By this method 90 per cent. of the oil can be removed, and in some cases the whole appears to have been abstracted.

The subject dealt with in this article is of great import to modern steam users where even a small percentage of economy is necessary, and one that should receive the most careful consideration of every one who is responsible for the laying out of steam plants, as well as of the proprietors of existing plants; a great saving may be effected on an initial outlay which need not be great.

THE COMMERCIAL ORGANIZATION OF THE MACHINE-SHOP.

By Hugo Diemer.

VI.—THE FIGURING OF TOTAL COSTS.

THE natural basis of selling prices is the shop cost. Competitors' prices must be considered, it is true; but no matter what these prices are, the shop cost must always be a positively known quantity.

The competitive system, by the necessity of meeting the prices set by rivals, has brought about pronounced economic advantages, when reductions in selling prices have followed similar reductions in cost through the introduction of labor-saving machinery or greater simplicity in design. On the other hand, many failures have resulted from blindly meeting prices set by others before actually reducing the shop costs of machines. This has been notably the case in the history of the manufacture of electrical machinery. Some ten years ago the establishments manufacturing machines of large capacity, for street-railway power and municipal-lighting plants, demanded high prices for machines of small capacity. This opened the way for numerous small factories, which for some years were able to sell the smaller machines at prices considerably lower than the large corporations, and were able to prosper notwithstanding the admitted fact that the large corporations could not meet their prices on small machines without loss. In some cases, it is true, inferior machines were put on the market by the smaller establishments, but in many cases the lower-priced machines were efficient and well-designed. The result was that the large corporations beset themselves to re-design their smaller machines, spending large sums in experiments for the purpose of obtaining cheaper insulating materials, for reducing the weight of the more-expensive metals employed, and for winding and insulating coils by machine. The result was that three or four years ago the large

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Prof. Diemer's papers began with the issue of THE ENGINEERING MAGAZINE for June, 1900. The preceding articles have been:

The Systematized Classification of Shop Orders.
The Production Department: Bills of Material.
The Production Department: Store-Room Management.
The Production Department: The Execution of the Work.
Practical and Accurate Time Keeping.

corporations were able to put on the market machines of lighter weight and more compactness than they had originally built, and, with improved methods of manufacture, were able to undersell the smaller manufacturers. Several of the small factories endeavored to meet the reduced prices, furnishing their heavy machines with expensive insulation and hand windings, and were unable to stand the pressure. On the other hand, other small shops have gradually worked up new designs and new methods until they are again in the field with machines practically identical with those of the large corporations, which they can afford to sell, without loss, at competitive prices.

It is apparent that during such transitional periods, a well-conducted cost-keeping system is indispensable. No progressive shop can allow the figuring of costs to drag months behind actual operations. It is necessary to know costs accurately and immediately. If the work of cost-keeping is turned over to an underpaid and overworked clerk, who has to expend all of his vitality in calculations of multiplication and addition and has no time left for comprehensive comparisons, accurate and valuable cost statistics cannot be obtained. The cost-department work is of such importance in a factory that it should receive the attention of the very best intellect obtainable. This fact has been recognized by one of the largest of American electrical corporations, the present general manager of which is a man who some years ago had charge of the cost department. And here it will be well to consider the advantage of departmental organization of clerical and accounting work, as well as of the factory proper. The cost clerk and purchasing clerk will be hampered in many ways if they are made subordinate to a book-keeper or superintendent, as is the case in many shops. A departmental separation has been found to be productive of far more accuracy, since the heads of the various departments will feel perfectly free to present matters just as they appear to them.

It is extremely important that the cost clerk or manager of cost department have time to think and to compare. In a small establishment he may be able to do a considerable amount of calculation work, such as extension of costs of material, but there are few machine-manufacturing establishments of any magnitude which would not find it a decided advantage to have available the comparative data that are obtainable if the whole time and energies of a man can be devoted to the work of intelligent arrangement and comparison of costs of individual pieces and entire machines.

In the application of the bill-of-material system, heretofore described in this series of papers, to the manufacture of electrical

machinery,* the labor costs were entered into the bill of material in the extreme right-hand column, headed "Cost of Labor," under each of the various sub-headings, such as "Armature Core," "Commutator," "Armature Coils," "Field Coils," etc., the total cost of the labor on each sub-heading in the various shop sections being entered as separate items. Thus we might have under the heading "Armature Core," the labor items "D—$3.49" and "A—$2.20," meaning that the work of section "D," or the punching department, amounted to $3.49 and the labor of section "A," or the machine-shop, amounted to $2.20 on the armature core of this machine.

After all extensions of costs of material and of labor have been entered on the bill of material, it is turned over to the manager of the cost department. If the bill-of-material system has been properly followed out, and all discrepancies in material attended to at once as soon as they were made evident by the store-room entries, there need be no delay in arriving at the total costs, the only operations necessary being the entering of labor costs and extensions of costs of material, so that complete cost bills can be had within a day, or at most two or three days, after completion of an order.

In order that material costs will be those current at date of manufacture, a small card index with a card representing each day of the month is useful for the clerk entering costs of material. On any day on which he is advised by the purchasing department of fluctuations in prices of material purchased, he makes a notation on the card representing that day, and as the bill of material shows just when material was drawn from store-room, he is able to insert the price current at time of using material.

The complete bills of material with cost entries are conveniently filed in "document file cases," a separate case being used for each order series, viz., the bills of material for "A" orders being filed in numerical succession by themselves; similarly the "B" orders, etc.

For quick reference to all machines of similar type and size, a card index should be kept, each card representing one certain type and size of machine, the order numbers being entered as machines of that particular size are completed. As there will be room on the cards for more than simply the order number, other brief entries may be made, which will frequently save reference to the complete bill. For instance, total weight, total cost, capacity, and speed, might be entered on the same line after the order number.

On receiving the complete cost-bill, the cost clerk looks up several

* THE ENGINEERING MAGAZINE, July, 1900, pages 515, 516.

similar machines on his card index, and gets the bills covering these from the document files. A careful comparison, item by item, is now made with the new bill just turned in. Any discrepancies are investigated and accounted for, and a note giving the results of the investigation is attached to the bill of material, which is now sent to the general manager, being noted by him and returned again to the cost department to be filed away.

In order to prevent delays, and to enable any bill of material to be located at any time, little record books may be kept by the cost clerk—one book for each order series—in which are noted the dates on which the bills of material are received and turned over to the various departments or clerks, the books being ruled as follows:

Order No.	Complete.	From Production Dept.	To Time Clerks.	From Time Clerks.	To Manager.	Returned.	Filed.
2307	10/2	10/3	10/3	10/4	10/4	10/11	10/11

The posting of labor for purposes of cost determination may be advantageously done on large sheets of good, rather heavy paper, punched at the top and kept on prong file boards. Here, as in many other instances, this method of keeping accounts has the advantage that only live orders have to be handled, since, as quickly as an order is completed, the page representing it is taken out, while in the case of a book, leaves representing dead material have to be constantly turned. Separate file boards will be used for the various order series, and the sizes of sheets used and their ruling will vary, as orders covering complete machines will require larger sheets and a greater amount of ruling than repair orders or orders for single pieces or parts.

As a basis for a price list for repair parts, it may be desirable to obtain total costs of groups of parts. For instance, in the case of a dynamo, prices may be desired for complete extra armatures, armature and field coils, individual brush-holders, journal bushings, etc. A card index may be kept for each such group of parts, a single card representing a certain size and type. Where the same individual part is used on several sizes of machines, it will be on but one card, the heading designating the sizes of machines on which it is used.

In determining the expense percentage to be added to the cost of labor as shown by the time records, the simplest process, and the one most generally used, is that of adding a uniform percentage to the cost

of labor on all classes of work. Thus, if the entire expense account of a factory, including the cost of unproductive labor, interest, insurance, depreciation, etc., is to the cost of productive labor as 150 is to 100, then one and one-half times the cost of labor on any article built in the shops will be added to its cost as shown by the bill of material and time records, in order to obtain the total cost.

This method, while simple, is objectionable because it does not differentiate articles in the manufacture of which the more inexpensive machines of a plant are employed, from articles involving the use of very expensive machinery. On the other hand, it adds a very great amount to the necessary clerical work if a definite percentage is determined for each tool and added daily to the operator's time. A compromise between these two extremes will be found in the differentiating of the output of a shop into several groups, and, by carefully examining the purchase cost and expense of operation of the tools employed in the manufacture of each group, similarly differentiating the expense percentage, so that a different per cent. will be added to the machines involving greater expense than to the group in which less expense is involved. Thus, let us suppose that the total annual cost of productive labor in a shop is $100,000, and that the total expense, including unproductive labor, interest, insurance, depreciation, etc., amounts to $150,000. We might determine the actual total cost of each machine now by adding one and one-half times the cost of labor as shown by the time records. But suppose we draw a line between the kinds of machines manufactured, putting all the larger and special machines in a group by themselves and all ordinary small stock machines into another group, and find now that the labor on the large machines amounted to $50,000 and the expense item on the same machines amounted to $100,000, while in the case of the smaller machines the labor cost amounted to $50,000 and the expense item for this group was $50,000. It is evident that we would cover our total annual expense item if we added twice the cost of labor as shown by the time records in the case of the large and special machines, and added once the cost of labor as shown by the time records in the case of the smaller machines. It is evident that the addition of one and one-half times the cost of labor to all machines would have been misleading, inasmuch as it would have represented the costs of the smaller machines as being higher than they actually were, and would have shown the costs of the larger machines at too low a figure. The addition of the single percentage would be quite likely to lead the management to the fallacious conclusion that they were unable to build small machines at

as low a cost as some of their competitors, who confined their efforts altogether to the smaller type, and might cause them to allow their efforts towards selling the smaller machines to flag and thus lose a line of business which would be in reality profitable.

Careful comparisons need to be made between the cost records of a shop and competitors' prices on complete machines and individual parts. The sales department should constantly be accumulating such data of competitors' prices from their bids. In all cases where it has been quite positively determined that prices have not been "cuts," and it is found that they are below what the shop can afford to quote, it is proper to investigate and see if some means cannot be found of meeting the competitors' figures. It is not a general rule that the members of a sales department are in position to ferret out for themselves the methods of meeting such competition. It is perfectly proper that the sales department should not confide its own selling prices nor those of its competitors to any other department of the shop. It is, however, of extreme importance that absolute truthfulness be observed in reporting to the technical departments the percentage by which a competitor has underbid the shop. A collection of competitors' prices may demonstrate that certain machines or lines of machines are costing the shop more than they ought to. It then becomes necessary to use every proper effort available to bring down the cost of the machine, and if the cost is cut down by legitimate means, an economic advantage has been gained not only for the shop, but, in a small way, for the trade at large. The constant reduction of prices of all manufactured commodities is by no means a sign of a demoralized condition of trade, but is a necessary essential to the world's progress. If this condition is met in a spirit of ill temper and haste, it is likely to result in business failure; but if it is taken hold of with intelligence and caution, it means success and prosperity to the manufacturer.

THE GENERAL PRINCIPLES OF SUCCESSFUL MINE MANAGEMENT.

By A. G. Charleton.

IT may seem almost self-evident that one of the secrets in conducting mining operations so as to secure a maximum of profit—the point naturally to be aimed at—is to get the largest amount of work that is possible out of each man employed, without "sweating" him but at the same time without overpaying him; and to secure the most useful effect that can be got out of the various machines in use, up to the full limit of their capacity, in the shortest possible time, without overtaxing them; that is to say, speaking generally, it depends on making the best use possible of the men and materials, placed by circumstances at the disposal of the manager of a mine.

Obvious as this proposition may appear in principle, however, it is apparently by no means always recognised, or acted upon in practice, or there would be fewer mining failures; whilst company's profits would often be increased in cases where profit may, to some extent, perhaps, be already earned.

Managers, indeed, often seem to fail to grasp the fact that the value, whether of men or machines, is the profit translated into money which their work represents when spread over a given period of time: consequently, the net profit or loss resulting from the undertaking is the difference between what I may term the "profitable and unprofitable units of work" accomplished in the aggregate.

If the former exceed the latter the business as a whole must necessarily be profitable, and *vice versa;* but it is often the case that individual carelessness or departmental inefficiency may reduce, if not entirely wipe out, profits actually earned in other directions, in which work has been executed with greater relative economy.

The various and complex factors determining the success or failure

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The modern era of mining, which has witnessed developments so enormous in South Africa, Australia, and the United States, has its source, first in the perfection of engineering methods which have reduced exploitation and mine surveying to an exact science, but scarcely less in the realisation that mining is not a gaming venture but a legitimate productive occupation, to be managed carefully, economically, and watchfully if success is to be attained.

The principles of management are akin to those actuating the direction of any industrial undertaking, but their adaptation is special to the field and as wide as its varied demands and opportunities. Mr. Charleton, in this issue, begins a treatment of the subject which will develop as great a range and as keen an interest as did the recent articles on shop management, appearing in this magazine.—THE EDITORS.

of any particular mining enterprise may be classed under two distinct heads:

(A) Uncontrollable, depending on the intrinsic value of the property itself, and its natural environment;

(B) Controllable, that is to say, dependent upon the efficiency of its general management.

The latter subject alone falls within the scope of this article.

Broadly speaking in this latter connection, I think it may be said that the measure of success attained in mine management depends upon the amount of judgment exercised:

(1) In the selection of the most suitable machinery and materials to effect various specific purposes.

(2) In the choice of men selected to perform any requisite piece of work, and in the way in which they are handled.

(3) In the employment of men and machinery collectively, in the execution of different jobs, so as to secure the best possible results at the least possible cost.

In addition to these primary requirements, however, tactfulness in dealing with people with whom a manager is brought into contact, whether in the position of directors, outside business-people, or subordinates, is a branch of his multitudinous duties second only in importance to resourcefulness in utilising the materials at his command, and in dealing with emergencies calling for prompt action. Above all, it is essential that he should possess that combination of practical, scientific, and business knowledge necessary for a mining-engineer to take full advantage of any improvements in technical practice, which will save labour, improve extraction, enlarge output, or otherwise cheapen production; finally, he should see that he is in a position to ascertain at a moment's notice exactly what is going on in every department of work which is not immediately under his own eye.

To consider all these matters in detail, I need scarcely say, would fill a library, and I will only glance briefly at the first three points I have alluded to, concentrating most attention, in the space at my disposal, upon the subject of "organisation"—a faculty which, when properly turned to account and applied, supplies a manager with a thousand eyes in place of a single pair, besides enabling him to unravel the commercial problems that the workman, or even the foreman in charge of a piece of work, knows nothing about, viz., the profit or loss which should result, or has resulted, in the execution of any particular job. It thereby guides him in shaping his policy to the best advantage to suit the circumstances he has to deal with. In a word, it places

him in a position to "boss the show," on proper business-lines, through knowing what he is talking about, what he wants, and what ought to be done, to insure a certain result. This is the position he should occupy, in place of being at the mercy of his subordinates.

It is this particular class of knowledge that differentiates a capable manager from others who, notwithstanding equal or even better opportunities, seem to have been born with a monocle and cannot always use even that to any appreciable advantage.

It is this faculty of "organisation," assisted by education, experience, and observation, cultivated by scientific training, as I shall endeavour to show presently, which enables a manager when underground, or when moving about the works, to use his eyes to a hundred times better advantage, however sharp he may be in noting all that comes within his own range of vision.

The danger to be avoided in this connection—which some managers insensibly fall into, however—is that of running to one of two extremes: either spending too much time in the "office," or too much time underground and about the works; in fact, it is a matter of the greatest importance for a mine manager to economise and lay out to the best advantage his own time, as well as that of other people, bearing in mind that he requires not only to see for himself what is actually going on, but to study its commercial results at his leisure; otherwise, without knowing the exact nature and quality of the work executed, he can never properly gauge its value in relationship to its cost.

The absurd idea that a manager should be as handy in "beating a drill" as the miner who is daily and solely employed in that operation is a relic of mediæval simplicity, although not entirely extinct, its embodiment being found in the demand that one still sometimes hears, for a so-called "practical" mine-manager. It is equally irrational to expect that a manager will be able to turn out assays or run survey-lines with the facility a man constantly engaged in such work can attain to; it is sufficient that he has had practical training in these various departments and is consequently acquainted with what others should do and are capable of doing.

To sum up: what is wanted for efficient mine management is the happy combination of general experience, engineering knowledge, and business capacity, regulated by administrative ability. A man may be, in fact, a first-rate engineer but a second-rate administrator, or the converse, and fail in either case where other managers with less ability in some one of these departments alone succeed. And in conclusion, if I may venture to give a piece of advice to the younger members of

the profession, it is this: neither lose time in tackling work that has to be done, nor attempt to rush things too rapidly (I mean in the sense of prematurely), and as the *raison d'etre* of the engineer is to overcome difficulties—he is not intended for an easy life—try to find some means to get over them; but when you happen to be in a difficult corner, follow Baden-Powell's advice: "sit tight," and stick to it until you succeed.

The Selection of Machinery and Materials.—To be able to place his hand on the proper article or piece of machinery for a particular job is an art which, as everyone who has tried it knows, is not to be acquired from makers' catalogues alone and cannot be learned in a day; in fact, it is only to be learned by experience, involving, as it does, a more or less thorough acquaintance with the relative merits, capacity, durability, price, and applicability of mechanical appliances of all kinds employed in mining operations. The chief point to be determined is whether quality and design shall be sacrificed to price, or whether it is cheaper to pay a higher price for a better article, the choice depending partly on the time any particular piece of machinery is likely to be required to last, partly upon its comparative suitability for the purpose for which it is to be employed.

How to choose the right man for the work to be done is a matter perhaps even more difficult than the selection of the proper material, if, as often happens with a shifting population like that of a mining camp, the personal equation of value is a comparatively unknown quantity at the moment choice has to be made. It is an art some managers seem to acquire more or less instinctively, whilst others master it with difficulty and many never do so at all. They get fooled by men they employ so often, and so thoroughly, that one really wonders whether they go wrong from choice, or from what my many American friends aptly call "cussedness." Needless to say there is no golden rule to go by nor golden road to knowledge of this class; it comes to those who seek it simply by experience of men and nothing more—bar their looks, and these may sometimes prove deceptive; but when you have found a good man, never lose sight of him, advance him if you can, and remember that his value is not measured by the wage you pay him so much as by the quantity and quality of the work he accomplishes. So-called "cheap men," like cheap materials, often prove the most expensive in the long run.

In dealing with his men, two things a manager should most carefully avoid are favoritism and undue familiarity; instead of conducing to his popularity these are sure to create jealousy and destroy the con-

fidence and respect the manager of a mine needs to handle a large body of workmen successfully. The worst possible mistake some managers make is to select a man simply because he happens to be a relation or fellow-countryman, or for some other personal reason; the only test that should govern advancement ought to be well-tried individual relative merit.

Mutual confidence between employer and employed, loyalty, *esprit de corps,* and discipline are likewise factors of great importance in running a mine successfully. A manager, if he is wise, will depend on his own judgment, discourage tale-bearing, and listen to no reports from his subordinates regarding their fellow-workmen or "shift-bosses," as he ought to be able to ascertain whether work is being carried out satisfactorily or not, and repose confidence in those under him until he finds it abused, giving each man a fair trial, and being careful to avoid jumping at over-hasty conclusions.

Loyalty to his immediate chief is owed by the miner or mill-hand to his shift-boss, and by the shift-boss to the mine-captain or mill foreman, in the same degree as these departmental officials owe loyalty to the manager or superintendent, and he, in his turn, owes it to his directors, who represent the shareholders in the concern. When loyalty is lacking, things generally go badly for everybody. Loyalty is a better force than fear of discharge in preventing miners from giving information about a mine which they have no right to do, before it is communicated to the head office, of which shareholders so often complain. Still more important is the *esprit de corps* of a body of men who are proud of their mine, take pride in their work, and work together to make it a success—which will often largely help to save an undertaking from failure.

To cultivate this spirit, whilst strictly enforcing discipline, is a matter to which every mine manager should devote attention. And whilst it is more or less an obligation he owes to his men, generally speaking, it will well repay him to take an interest in their comfort and well-being. By looking after their safety, starting cricket and other clubs, and encouraging them to improve themselves in their leisure (if they care to take advantage of it), a manager can show his friendship for those under his charge in a manner which they can appreciate, and the result tends to promote the well-being of the whole concern.

In fact, it is practically certain that if you want to get the best possible value out of men, the way to do so is to pay them well, treat them impartially, keep them in health with exercise, and train and educate them as far as they can go with advantage to themselves, this latter

factor depending, of course, on the amount of brain, industry, and ambition that each individually possesses; and although opinions may perhaps differ on the subject, my own experience is that one can get more profitable effect out of a body of miners, with six days' honest hard work on 8-hour shifts, spurring them to effort through taking pride in what they do, than by any amount of "bullock-driving" in seven days. Where seven days' work is necessary, limit it as far as possible to repairs and certain work which must be kept going.

The employment of men and machinery collectively in the execution of different jobs, so as to secure the best possible results at a minimum cost, calls for practical experience in mining, metallurgical, mechanical, hydraulic, electrical, and other dynamical questions, demanding a more-or-less thorough general knowledge of strength of materials, the design of structures, types of machinery, and the adjustment and operation of various machines.

In cases of sufficient importance, questions of this kind are frequently, however, entrusted to a "specialist," a course which it is always wise to adopt unless the manager happens to be specially posted in the subject. A superintendent who is "jack-of-all-trades," like the handy man who professes to know everything, is usually a failure.

Amongst the subjects most frequently falling within this particular branch of a manager's duties might be mentioned:

1. The organisation of the actual underground mining work, which is greatly facilitated by a careful study of the geological and mineralogical character of the ore-deposit itself, neighbouring mines, and the geology of the surrounding district.

2. The installation of the most suitable mechanical appliances, aided by manual skill, with a view to secure the rapid development, cheap extraction, and convenient transport of the ore, in addition to the removal of water and the lighting and ventilation of the mine workings; as well as means to obtain proper access to the various working-places.

3. Supervising the preparation of general designs and plans for the internal arrangements of surface buildings and reduction works, so as to reduce working costs by economising and facilitating labour. This matter frequently depends to some extent upon the sites selected when laying out the works, in respect of the advantages they offer for the delivery of ore, fuel, and fluxes, for securing an adequate water-supply, and for the disposition of tailings or other products, whilst permitting the best arrangement of machinery.

4. The adaptation and application of the process selected to the

extraction of the metal sought, so as to obtain it at a minimum cost, and to prevent loss of valuable mineral.

These and kindred questions are matters which a manager has frequently to settle, although some of them may already have been decided for him by his predecessors in office and in consequence be beyond the range of his control. It is therefore, as a rule, a great advantage to have a free hand in the original laying-out of the mining work and plant.

In the organisation of the work under his charge, my own view is that the manager should endeavour to trust as much as he can, without trusting too much, to the various heads of departments acting under him—stimulating them to use their brains and exercise independent judgment when occasion calls for it, and to look to him for advice only when in doubt or difficulties. That is to say, having given a foreman general instructions, I always make it a rule myself never to interfere with the way in which he carries them out, if it can be avoided, but to hold him responsible for its proper execution.

Matters which specially fall, however, within the province of the manager to attend to personally, and on which he should particularly post himself are:

1. The mining laws and regulations of the district in which the property is located, the past history of its mines, and the progress of their development.

2. Local labour problems, which influence questions of management, such as hours of work, wages, and an adequate supply of efficient labour; the avoidance, so far as possible, of giving needless occasion for disputes with labour-organisations by ill-advised action; seeing also that any funds set apart for the benefit of the workmen are properly administered.

3. The general mining and surface-work going on, to be ascertained by personal examination and by studying the reports that should be submitted periodically by the various heads of departments.

4. The developments in progress and the "reserves of ore" opened up, which should be shown on an "assay-plan" and personally checked from time to time.

5. The cost of every branch of work, as governed by the way it is laid out, output of ore, price and quality of materials used, and the wages and efficiency of the workmen engaged upon it—all of which should receive constant attention.

6. Matters of general business involved in carrying on local correspondence, telegrams on various subjects, letters, cables, and reports to

the head office, checking the general-accounts, stores-invoices, reports of heads of departments, and receipts and expenditures; besides watching "exchange" when called upon so to do, and making proper provision for meeting current expenses, outstanding indebtedness, and future liabilities.

7. The drawings and plans for the erection or alteration of machinery, buildings, etc., mine-surveys, and assay-plans.

8. The terms of all contracts, specifications, and tenders, so that work may be executed properly and at the lowest possible rate.

A manager who attends to these matters properly will not find time hang heavy on his hands, and he will deserve whatever holidays he can get, even given a thoroughly efficient staff, without which it is of course impossible to conduct the business of any mine properly.

I use the term "manager," however, advisedly in the above connection, as these duties, or some of them, are at times undertaken by a local consulting engineer in charge of a group of mines, when one property by itself is not of sufficient size and importance to need or afford the exclusive services of a highly-paid manager. At other times, some portion of them may be entrusted to a local board of directors, acting under the advice of a consulting engineer, as is frequently done on the Rand.

In the case of a property in an isolated position, and not in a large mining centre like Johannesburg, such an arrangement is not, however, always feasible, even supposing it to be desirable; and a manager may be called upon to supervise all or most of the matters I have mentioned entirely himself. But if the mine is a large one, the commercial part of the business may be placed in charge of a business-manager, or commercial-superintendent, who should, however, act under the instructions of the general manager or consulting engineer as the case may be, and not as an independent official; otherwise a company is certain to suffer from the troubles which invariably arise from dual managership; one responsible head is an essential, in my opinion, for the proper conduct of business of any description.

Whether the business is divided up for the sake of convenience, or not, makes little difference as regards the actual scope of a manager's responsibilities, for the direct supervision of the details in each department must in any event be left to his staff, and his business is chiefly to see that their immediate duties are properly carried out.

The staff under the general manager in exceptional cases may consist of a business-manager, an assistant manager, metallurgist, assayer, mine-surveyor, mechanical engineer, mine-foreman, mill-foreman, sur-

face-foreman, accountant and cashier, wages-clerk, and store-keeper; but in small concerns the duties of several such officials would naturally be merged into one, whilst special cases may demand putting on a special man to supervise some particular branch of work.

No fixed rule can be laid down as to the amount of supervision necessary, except the general principle that all work on which a sufficient number of men are employed requires effective direct control, and the amount each head of a department can supervise depends on how much there is to look after and how much he can properly attend to in the time at his disposal. This may vary from a 12-hour, to more-or-less of a 24-hour day, the manager not unfrequently being called upon to make a round on night shift.

Next to labour, economy in the use of explosives and timber underground, and fuel and water on surface, are the chief factors which determine the cost of mining operations. The storage and handling of explosives, so as to avoid accidents, facilitate their distribution, and prevent theft, and the character and quality of the explosives used, and the system adopted in using them, so as to secure the best results, should therefore receive the manager's personal attention.

Where rock-drills are employed, a manager has therefore to consider a number of points that bear on this subject: the best type of machine to use, the machinery employed for the supply of air and its distribution to the working-places, the handling and care of the machines underground, and the way of applying the explosive selected. Records of this work must of course be adapted to suit each case, but in the best-regulated mines particulars of shaft-sinking should be tabulated for reference—the total number of rounds drilled, the average, as well as the longest and shortest, time occupied in "drilling" each round, the average time taken in cleaning up, the longest, shortest, and average time taken in drilling and cleaning up, the average depth sunk per round, the total depth sunk per month, and the depth and position of holes in each round, shown diagramatically. In addition, details of the quantity of explosives consumed and the time taken in the various separate operations of drilling, charging and firing, and cleaning up are occasionally called for.

In "driving" again, whether "speed," or "price per foot," is the main object, it is frequently desirable to ascertain and tabulate the results, with a view, if possible, to "beat the last record."

The support and timbering of working-places in a safe and economical manner is another important matter to look into, upon which much might be said, but space only permits me to refer the subjoined

list of authorities. The seasoning and preservation of timber are also subjects that will often repay looking into.

Underground haulage and storage of ore, pumps, ventilation, and hoisting machinery require to be looked after, whilst frequent visits to the shops, magazines, stores, mill, or other surface works, I need scarcely say, claim no inconsiderable part of a manager's time.

Beyond all this, a manager requires to see that developments are pushed ahead on systematic and proper lines; not, as is too frequently the case, in a haphazard "where it is, there it is" fashion, but with a definite object in view, based on a sound interpretation of the geological evidence at his disposal. He should make sure that the stopes are carried to the right width and laid out properly, and that due attention is paid to sorting out waste, if necessary; and he should satisfy himself that proper checks are kept on the quantities of ore won or trammed from different sections of the vein or deposit, and of the value of the lode, where it is being opened up.

To check quantities of ore delivered, as ascertained by keeping a proper system of "tallies," underground and on surface, the manager should see that the "stopes" are properly and regularly measured up by the mine surveyor. To see that a proper assay-plan is constructed and kept up to date should be one of the chief matters to which a manager should devote care, bearing in mind the fact that the value of assays depends entirely on the accuracy of the sampling.

On the surface, the storage, conveyance, sorting, crushing and treatment of the ore need attention, and the records of a mill, cyanide works, or smelter require to be so kept as to show the quantity and value of ore treated, percentage of extraction and tailings-assay, labour, fuel, water, fluxes, supplies, etc., used, and the value and amount of the resulting products; the manager making it a special point to assure himself that no gold is being stolen from the mine itself, and that returns of amalgam and bullion are properly checked, by being always present, if possible, when there is a "clean-up."

Of course to control effectively work constantly going on, a manager should be more or less thoroughly acquainted with such subjects as applied mechanics and machine-shop practice, blacksmith's work, carpentery, and the design of structures. Photography, first aid to the injured, and a knowledge of the proper treatment in ordinary cases of illness, although scarcely falling within the scope of his duties, are at times also very useful subjects to know something about.

It is a part of his duties to see that the assay department and bullion department (if the property is a gold mine), are properly organ-

ised, cordwood is regularly measured up, stock is taken of stores, invoices are compared with goods delivered, and that regular reports are made by the mechanical engineer or whoever is immediately responsible, upon the condition of the machinery in different departments, showing that boilers have been tested and cleaned when necessary, their individual consumption of fuel and water ascertained and recorded, and that diagrams have been taken of the engines used for winding, pumping, air-compressing, and driving mill machinery. Revolution-counters may be attached with advantage to such engines as air compressors, operating under variable loads, whilst pumps or pumping engines should have a card kept close by, on which is noted daily time of starting and stopping, number of strokes, etc. A manager should satisfy himself that renewals and repairs are properly looked after, and charged up; more especially that winding-ropes and signalling and safety-appliances are regularly and thoroughly inspected, and that a record is kept of the life of the different wearing parts of the machinery.

The limits of an article of this kind might, however, be indefinitely extended, if I attempted to deal with all the subjects a mine manager may at times be called upon to take in hand and supervise. I have only named those that are of most importance to call attention to, indicating where information respecting most of them can be obtained, so far as it can be learnt from books. In a following article I shall take up, with the aid of forms and record blanks, the office work, and especially the very important matter of accounting, book-keeping, cost-keeping, the classification of expenses, and the making up of statements.

The following works will be found of service and value in the specialised treatment of the several branches of mine management indicated by their titles:

Ore and Stone Mining; C. Le Neve Foster. Chas. Griffin & Co., London.

A Handbook of Gold Milling; Henry Louis. Macmillan & Co., London and New York.

Treatment of Gold Ores; Wm. McDermott and P. W. Duffield. E. & F. N. Spon, London.

Stamp Milling of Gold Ores; T. A. Rickard. The Scientific Publishing Company, London and New York.

The Choice of Coarse and Fine Crushing Machinery and Processes of Ore Treatment; A. G. Charleton. Trans. Federated Inst. of Mining Engineers.

Hints on Amalgamation and the Care of Gold Mills; W. J. Adams. Modern Machinery Publishing Company, Chicago.

California Gold Mill Practice; C. B. Preston. Bulletin No. 6, the California State Mining Bureau.

Gold Mills of the Rand; Dr. F. Hatch and J. A. Chalmers. Macmillan & Co., London and New York.

Clorination, Concentration, etc., treated of in articles by John Rothwell, Prof. Richards, and others in the Mineral Industry. The Scientific Publishing Co., New York and London.

The Witwatersrand Gold Fields; S. J. Truscott. Macmillan & Co., London and New York.

Practical Notes on the Cyanide Process; F. S. Bosqui. The Scientific Publishing Co., London and New York.

Present Day Metallurgical Engineering on the Rand; John Yates. London Mining Journal.

The Cyanide Process; Dr. A. Scheidel. Bulletin No. 5, The California State Mining Bureau.

Papers by Alfred James, M. Eissler, and others; Transactions of the Institute of Mining and Metallurgy.

Cyanide Plant and Accessories; the Cyanide Plant Supply Company, London.

Catalogue, 1899, Bromo-Cyanide; the Gold-Ore Treatment Company, Ltd., London.

Matte Smelting; H. Lang. The Scientific Publishing Co., London and New York.

The Lixiviation of Silver Ores with Hyposulphite Solutions. The Scientific Publishing Company.

Modern Copper Smelting, 7th Edition; Dr. E. D. Peters. The Scientific Publishing Co.

Lead and Copper Smelting; H. W. Hixon. The Scientific Publishing Co.

The Metallurgy of Lead, 5th Edition; H. C. Hofman. The Scientific Publishing Co.

The Metallurgy of Lead; H. F. Collins. Chas. Griffin & Co., London.

A Text Book of Assaying; C. and J. Beringer. Chas. Griffin & Co., London.

A Hand Book of Modern Explosives; M. Eissler. Crosby, Lockwood & Sons.

The Blasting of Rock; A. W. and Z. W. Daw. E. & F. N. Spon, London.

Mitchell's Manual of Practical Assaying.

A Text Book of Plane Surveying; W. G. Raymond. The American Book Co.

Treatise on Mine Surveying; B. H. Brough. Chas. Griffin & Co., London.

Mine Drainage; S. Mitchell. Crosby, Lockwood & Co.

Mine Drainage, Pumps, etc.; Hans Behr. Bulletin No. 9, California State Mining Bureau.

Cornish Mine Drainage; S. Mitchell and J. T. Letcher, 43d Annual Report Royal Cornwall Polytechnic Society.

Care of Wire Rope; J. Shakespeare. Report of the Secretary of Mines, Queensland, 1894.

The Practical Steam Engineer's Guide; E. Edwards. H. C. Baird & Co.

Steam and the Steam Engine; Dr. Evers. W. Collins & Co.

Gas, Air and Oil Engines; B. Donkin. Chas. Griffin & Co., London.

Dynamo Electric Machinery; Silvanus P. Thomson.

Electric-Power Transmission; Dr. Louis Bell.

Mine Timbering; W. H. Storms. Bulletin No. 2, California State Mining Bureau.

Report Book for Mining Engineers; A. G. Charleton Whitehead. Morris & Co., London.

Lock's Miners' Pocket Book. E. & F. N. Spon, London.

Practical Engineers' Hand Book; W. S. Hutton. Crosby, Lockwood & Co.

The Works' Manager's Handbook. Ibid.

Estimating and Sampling Ore Reserves; W. Wybergh. Trans. Inst. Mining and Metallurgy, London. Vol. IV., 1895-6.

Graphic Assay Plans; W. Wybergh. Ibid, Vol. V. 1896-7.

A Graphic Method of Estimating Ore Reserves; A. G. Charleton. Ibid, Vol. IX, 1900-1901.

Observations on Sampling, etc.; G. A. Denny. Trans. Inst. Mining Engineers, Newcastle-on-Tyne, 1900.

Mine Sampling; W. McDermott. Trans. Inst. Mining and Metallurgy, London.

Very useful information may be derived also from the catalogues of makers of mining machinery, as, for example: Fraser & Chalmers, Ltd., and the Gates Iron Works, London and Chicago; the Union Iron Works, Risdon Iron Works, and Park & Lacy, San Francisco; the Sandycroft Foundry, Chester, England; Appleby & Co., London; Chester & Co., Renfrew, Scotland; the Rand Drill Co. and Ingersoll Sergeant Drill Co., New York and London; California Wire Works, San Francisco; Bullivant & Co., London; Bullock Mfg. Co., Chicago; Messrs. Islers, London; the Trenton Iron Co., Trenton, N. J.; Sullivan Machinery Co., New York and Chicago; the Bucyrus Co., South Milwaukee, Wis.; Marion Steam Shovel Co., Marion, Ohio; the Vulcan Iron Works, Toledo, Ohio; the Jeffrey Mfg. Co., Columbus, Ohio; the Diamond Coal-Cutter Co., Messrs. Ernest-Scott and Mountain, and the leading manufacturers of machinery everywhere whose advertisements may be found in the technical periodicals.

THE LOCOMOTIVE EXHIBIT AT THE PARIS EXHIBITION.

By Charles Rous-Marten.

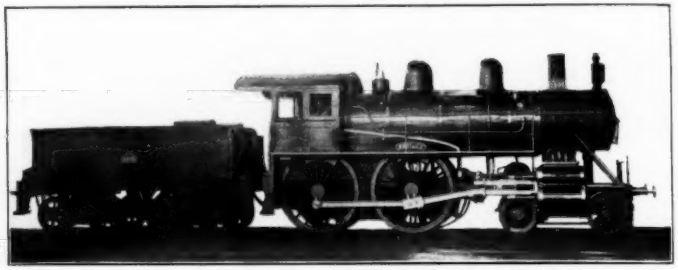
PURSUING my idea that the salient principle of the Exposition of 1900, so far as locomotives are concerned, is *increased haulage power,* I come next to the special method of attaining that end, which the present Exposition has brought to the front in so remarkable a degree. I mean the development of compounding.

I have already said that, outside of the British section, by far the larger number of engines are constructed on one or another of the numerous compound systems which are now on their trial in Europe and America, some of which, indeed, have virtually passed the stage of trial and have become accomplished facts and recognised successes. It forms no part of my present programme to appraise their relative and proportional popularity. But in view of the fact that every leading railway in France is represented, as are also certain German and Swiss lines, by one locomotive or several, all constructed on one particular system of compounding, however much they may differ in general design or in details, I think I am warranted in according a certain prominence to that system. It is the one invented by Mons. A. G. de Glehn, director-general of the Société Alsacienne de Construction Mecaniques, which has such vast workshops at Belfort and Mulhausen, *i. e.*, respectively on the French and German sides of the Alsacian frontier of France and Germany.

In my article on the locomotive work of the Northern Railway of France, published in THE ENGINEERING MAGAZINE of February, last year, pp. 784-798, I gave a general description of the de Glehn compounds as designed by Monsieur du Bousquet, ingénieur en chef, and built for that line. Since that date, that is to say, during the years 1899 and 1900, engines of various designs, in which this system of compounding is employed, have gradually taken possession of all the French main lines. On the Midi, Etat, and P. L. M. railways, indeed, they were to be found even prior to 1899, but they now perform the most important passenger services also on the Orléans, Est, and Ouest lines. More than 800 locomotives constructed on this system are now at work on the European continent.

Mr. Rous-Marten's first article on this subject appeared in THE ENGINEERING MAGAZINE for September.

The Chemin de Fer de l'Etat, or State Railway of France, has, however, recently placed on its road four express engines of the four-cylinder compound type, but of a different design, viz., the Vauclain, which is so largely in use on the American continent. These engines were built by Messrs. Burnham, Williams & Co. at the Baldwin works, Philadelphia, and one named "Montlieu" is to be seen at Vin-

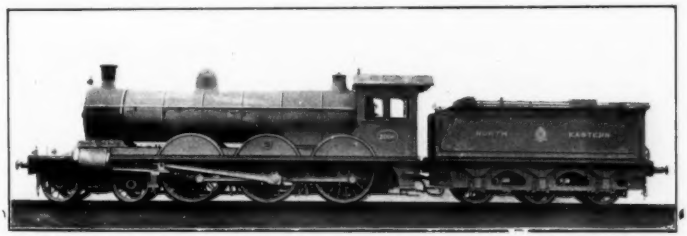


THE MONTLIEU, VAUCLAIN COMPOUND. BUILT AT THE BALDWIN WORKS, PHILADELPHIA, FOR THE STATE RAILWAY OF FRANCE.

cennes. The Vauclain system differs from the de Glehn mainly in having all its four cylinders placed outside the frames, the high-pressure being superposed above the low-pressure, and in the two piston rods on either side driving on to one cross-head, whence the connecting rod propels the rear pair of coupled wheels. Thus all the four cylinders drive the same axle and pair of wheels, as in the case of the Webb compound "La France," but in the latter case the two high-pressure cylinders are outside and the two low-pressure cylinders inside, as in the de Glehn system, in which, however, each pair of cylinders drives a different axle. The use of a single axle for the transmission of the whole propulsive power of the locomotive is to be found also in the four-cylinder tandem compounds, of which several instances are to be met with at Vincennes, and in the two-cylinder systems of Mallet and von Borries. Theoretically, no doubt, the heavy strain placed on a single axle by subjecting it to the pull of four cylinders is undesirable. When two cylinders are inside and two outside, as in the Webb engine, the axle has all the disadvantages which attach to those of outside cylinder engines on the one hand, and of inside cylinder ones on the other. That is to say, it unites all the drawbacks which theoretically are associated with straight axles and cranked axles respectively. The essential inherent weakness in shape of the cranked axle, regarded as a column, needs no demonstration at all. But it has been claimed—and experience seems to support the claim—that this weakness has virtually been overcome by improved methods of con-

struction, such as the "building-up" plan which is employed, I believe, both on the London & North Western and the Midland lines, or the circular web device adopted by the North Eastern. Personally, I am disposed to think that, with modern excellence of design and construction, such as is found in Great Britain and France, to which countries the use of cranked axles is almost exclusively confined, there is very little to choose between the two kinds in respect of safety and efficiency. In America and throughout the greater part of the European continent the cranked axle is, I believe, almost, if not wholly non-existent, excepting in the case of those designs of four-cylinder compounds in which two of the cylinders are placed inside the frames. The theoretical disadvantages attaching to the employment of a single driving axle with four cylinders do not appear to have made themselves felt in actual practice.

It is somewhat singular that with respect to the four purely British locomotive exhibits—those designed and built in England for the use of English railways—exigencies of construction should have compelled the adoption of outside cylinders in two out of the four cases, notwithstanding the strong British preference for the inside position. Mr. F. W. Webb placed his two 15-inch high-pressure cylinders outside the frame in the case of his compound engine "La France" because he could not get them inside, all the available space in that position being occupied by the two 20½-inch low-pressure cylinders. Mr. Wilson Worsdell was obliged to place his cylinders outside in his non-compound engine, No. 2006, because with six-coupled wheels 6 feet 1



NON-COMPOUND SIX-COUPLED EXPRESS ENGINE NO. 2006, NORTH EASTERN RAILWAY, ENGLAND, MR. W. WORSDELL, CHIEF MECHANICAL ENGINEER

inch in diameter, 20-inch cylinders with a 26-inch piston-stroke could not well have been placed at such an incline as would have enabled the connecting rod to clear the leading coupled axle.

But in the other two British locomotives, Mr. S. W. Johnson's Midland express engine "Princess of Wales," and Mr. J. Holden's Great Eastern liquid-fuel-burning express engine "Claud Hamilton,"

the inside position is employed as a matter of course. As regards this particular method of construction, the practice of England diverges as markedly as ever from that of most other countries, notably the United States. Modern British engineers will not use outside cylinders unless absolutely forced to do so by some peculiarity in the plan of their engines. In my articles of last year on British and American Locomotive Practice I set forth the arguments commonly adduced.

I have already referred to the general development of haulage power in the engines shown as compared with those exhibited on former occasions. As the compound method has come into use mainly since the last Paris Exposition, and as the vast majority of the locomotives displayed in this instance are compounds, it is not easy to institute any precise statistical comparison between the relative tractive force possessed on the average by the locomotives of 1889 and those of 1900. I mean that, in view of the many discrepant and discordant estimates which exist as to the proportionate power exercised by a given cylinder diameter in a compound locomotive engine as against that of a non-compound, one cannot safely take the customary basis

$$\frac{\text{cylinder-diameter}^2 \times \text{piston-stroke}}{\text{diameter of driving-wheel}}$$

—all in inches—because the results might be widely misleading in view of the difference among the designers of compound engines in respect of the best proportions between high-pressure and low-pressure cylinder dimensions. But the striking and valuable development of the past decade has been in the most important direction of all, namely in boiler-power and steam-pressure. For whereas in 1889, a boiler with 900 to 1,100 square feet of heating-surface was deemed ample for many of the most prominent express engines in England, such as those of the Great Northern and South Eastern lines, and a total heating surface of 1,200 to 1,300 square feet was rarely exceeded, there are very few main-line engines at Vincennes, other than British, which have less than 1,800 to 2,000 square feet, and even two of the four purely British express engines shown have 1,630 and 1,768 square feet, respectively, while M. du Bousquet's new engine for the Northern of France line, No. 2.642, has no less than 2,275 square feet. Again, in 1889 a steam-pressure of 160 pounds to the square inch was the maximum in ordinary use; 175 pounds was comparatively rare and was regarded as more or less of an experiment of dubious value. But in 1900 a large proportion of the engines at Vincennes have 200 pounds steam pressure or more. Most of the new French locomotives have 213 pounds at the least, and the newest of all, M. du Bousquet's

huge ten-wheeled "Atlantic" type, express No. 2.642, for the Northern line, and M. Salomons' eight-wheeled express engine, No. 2.411, for the Eastern Railway of France, have each a steam-pressure of no less than 228 pounds to the square inch. Of the four English engines, two —the London & Northwestern and North Eastern exhibits—have 200 pounds of steam pressure; the Great Eastern engine has 180 pounds, and the Midland 170 pounds. In this respect as in that of boiler-size, British progress travels on the lines of the old motto of one of its leading families, *Festina lente*"—"hasten slowly."

It is somewhat remarkable that the four British engines should differ so widely as they do, one from another. For it would have been possible to exhibit representative British engines from a number of railways which would all have been designed on identical main principles and which would have varied only, or chiefly, in dimensions and details. For instance, express engines—and new ones too—might have been shown by the Great Western, London & South Western, London, Brighton & South Coast, South Eastern, London, Chatham & Dover, Great Eastern, Great Northern, Midland, North Eastern, Great Central, Lancashire and Yorkshire, North British, Glasgow and South Western, Caledonian, Cambrian, North of Scotland, and Highland lines, all being among their most recent types and all agreeing in having inside cylinders, four-coupled driving-wheels 6 feet to 7 feet in diameter, and leading bogies. But the Great Eastern engine designed by Mr. Holden is the only British one at Vincennes which possesses all these characteristics. Mr. Webb's London & North Western engine is a four-cylinder compound with outside as well as inside cylinders; Mr. Worsdell's North Eastern engine has six-coupled driving wheels and outside cylinders; Mr. Johnson's Midland engine has single drivers 7 feet 9 inches in diameter. Here is as marked a variation as could well be found. The explanation, of course, is that each company and its chief mechanical engineer have exhibited what they deem to be their latest improvement in design and the type which they expect to become the standard one for the future. One could not help regretting that such new and interesting departures as Mr. W. Dean's "Atbara" (Great Western), Mr. D. Drummond's "720" (London & South Western), Mr. H. A. Ivatt's "Henry Oakley" (Great Northern), Mr. J. A. F. Aspinall's "1400" (Lancashire & Yorkshire) and Mr. J. F. M'Intosh's "900" (Caledonian) have not found a place.

One thing which must promptly strike the most casual observer is the exquisite finish of the work put into the four British engines that

are shown. And the more closely these locomotives are inspected the more obvious does this characteristic become. Every part, every detail, whether in sight or out of sight, is as delicately finished as if it were a portion of a chronometer. The same thing may be noticed in the case of a large number of the European engines. I am compelled to be candid in order to be just and accurate in my remarks, and candour forces me to say that this extreme finish is conspicuously absent in much of the work in the American engines. Indeed, the roughness of the jointing is in some instances quite surprising when it is remembered that the engines are exhibited as displaying the finest qualities of American workmanship in that particular branch of engineering manufacture. Nor is there the slightest attempt to conceal these roughnesses. Clearly this lack of delicate finish is not deemed by builders a defect of which they need be ashamed. How is this?

I incline to the opinion that, as it forms one feature of American locomotive-building policy to construct engines that will do all they are required to do and have even a margin to spare, but that shall not have a needless dollar expended upon them for purposes other than those of strict utility and shall not last so long as to become archaic while still too good to be "scrapped," so it forms no part of the American policy to conceal this method. Rather is it openly confessed by its frank obtrusion on the exterior surface of the machines. I have treated this question somewhat fully in my earlier articles on British and American locomotive practice and have entirely recognised that each country's system has much to be said in its favour, while open to various possibilities of hostile criticism. I need not retrace the ground over which I then travelled, especially as I shall have more to say on the subject when I come to treat of the working of American locomotives in Britain and in British possessions.

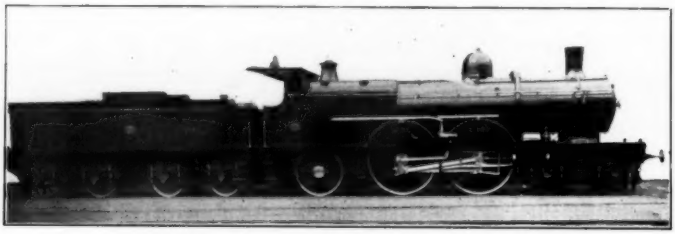
But I cannot quite follow my friend, the very able editor of *The Engineer*, in his conclusion that the American locomotives exhibited at Vincennes are likely to come to the scrap-heap after four or five years' work, and, indeed, are intended to do so. This I think is putting the case in its most extreme aspect, which is also one of some rhetorical exaggeration. I prefer to maintain my own view, already expressed—that whereas the British engine is designed and built to last thirty or forty years and so runs long after the type has become obsolete, the American engine is designed and built to last only ten to fifteen years, so as to be destructible without remorse so soon as a more modern type would advantageously fill its place. I express no final judgment on the merits of the alternative courses.

Next to the purely British exhibits—according to my definition of the term—comes an exhibit by a British firm of builders of a locomotive constructed by them for a foreign railway. I refer, of course, to the fine express engine "Koningin Wilhelmina," built by Messrs. Neilson, Reid & Company at their Hyde Park works, Glasgow, for the Central Netherlands Railway, having been designed by Mr. J. W. Verloop, chief mechanical engineer of that railway. I illustrated the engine last month. It is of a strongly British type, but is able to have a higher chimney and dome cover than would be admissible in England, superior altitude being allowed by the Dutch loading-gauge.

Following the British-built locomotive constructed for a foreign railway may reasonably come the American-built engine supplied to an English railway and ostensibly exhibited by the latter. This, too, may be taken as one of a hybrid class. It is a goods engine of the "Mogul" type with leading two-wheel pony truck, six-coupled wheels 5 feet in diameter, outside cylinders 18 by 24, 1,380 square feet of heating surface and 170 pounds' steam pressure. It is one of the "emergency" locomotives ordered from America owing to the impossibility of getting them built in Great Britain soon enough to meet

GREAT NORTHERN NO. 1200, BUILT BY BURNHAM, WILLIAMS & CO., AT THE BALDWIN WORKS, PHILADELPHIA, U. S. A.

urgent traffic requirements. It was built by Messrs. Burnham, Williams & Co., at the Baldwin works, Philadelphia, and is as a matter of fact exhibited by that enterprising company. It bears the Great Northern number 1200. It is unnecessary to devote much attention to this exhibit, because while the type is useful and efficient enough for practical purposes, it is not at all what would have been designed by an American engineer for the class of duty it has to perform. Nor is it either in respect of details the sort of engine that would have been ordered by an English engineer, excepting for the urgent necessity of accepting what could be got at the time. But it is a masterly commer-



NORTHERN RAILWAY OF FRANCE, NO. 2.642

cial stroke of the American builders to show their engine to the whole world as an accredited specimen of the latest thing adopted by so progressive a British railway as the Great Northern. There is an ingenuity in this advertisement that it is impossible to help admiring.

But Messrs. Burnham, Williams & Co. have done more than this in the same direction. They have on show at Vincennes a very fine Vauclain-compound express engine, constructed at the Baldwin works to the order of the State Railway of France, and ostensibly exhibited by that railway together with one of its standard express engines on the de Glehn system. The Vauclain compound supplied to the Etat railway is of the ordinary American type. It has two 13-inch high-pressure cylinders, and two 22-inch low-pressure cylinders, all placed outside. The piston-stroke is 26 inches. The four-coupled driving-wheels are 7 feet in diameter. The total heating surface is 1,903 square feet, and the steam pressure is 213 pounds. The engine weighs 54 tons in working order and has 31½ tons' tractive adhesion.

Notwithstanding the lack of that minute and delicate "watch-finish" which is to be found in the British engines, and the absence of which in this case is so strongly commented upon by certain British critics, my own experience of American engines in various lands impels me to anticipate that this one and its brethren will be found to perform excellent service on the State Railway of France.

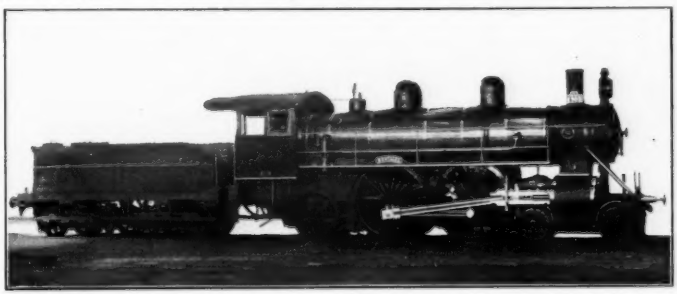
The type of engine which has more representatives than any other in the Exhibition of 1900 is the four-cylinder compound on the de Glehn system, illustrations of which are shown by every leading railway in France—the Nord, Orléans, Etat, Midi, P. L. M., Est, and Ouest—while several of these lines show more than one class of locomotives constructed on this system. In my previous article I referred to the magnificent express engine which represents the most recent development of the system, that designed by Monsieur du Bousquet, ingénieur-en-chef for the Chemin-de-Fer du Nord, and numbered 2.642.

Making a special trial of this engine I found it able to take a heavy express weighing 305 tons (English) behind the tender, from Paris to St. Quentin, a distance of 95¾ miles, in 90 minutes 52 seconds, start to stop, maintaining an average of 62.1 miles per hour up a 13-mile rising grade at 1 in 200—the minimum rate being 59.2—and 74.5 miles per hour on a long stretch of level and slight ascent. Down the falling gradients the speed was not permitted to exceed the limit prescribed by law, namely 120 kilometres or 74.5 miles per hour. This performance has no parallel in my personal experience.

The exhibits of the other French railways may be summed up in the remark that they are mainly variants of the Nord engines, formerly described by me, that is to say, they are four-cylinder compounds on the de Glehn system, with such differences and modifications of design as were deemed by the respective ingénieurs-en-chef suitable to the individual requirements of the particular lines.

One engine, however, belonging to the State Railway of France, which is shown at Vincennes, is in reality the exhibit of the Baldwin works, where it was designed and constructed. It is a very fine 7-foot coupled non-compound express engine of the Atlantic type, and is one of ten supplied by Messrs. Burnham, Williams & Co. to the Chemin de Fer de l'Etat. The French Midi company show a six-wheeled coupled engine of the "Mogul" class which has been converted from non-compound to the two-cylinder compound type.

The engines shown by the P. L. M. Railway of France, and also one of those exhibited by the State line, have the "wind-cutter" fronts that have so long been in use on the P. L. M line, not only the smoke-box but also the chimney, the dome-cover, and the cab being shaped so as to present a prow or acutely-angled wedge to the air passed through by the engine. As careful experiments have shown that the resisting



THE MONTAIGU, NON-COMPOUND ATLANTIC-TYPE ENGINE. BUILT AT THE BALDWIN WORKS, PHILADELPHIA, FOR THE STATE RAILWAY OF FRANCE

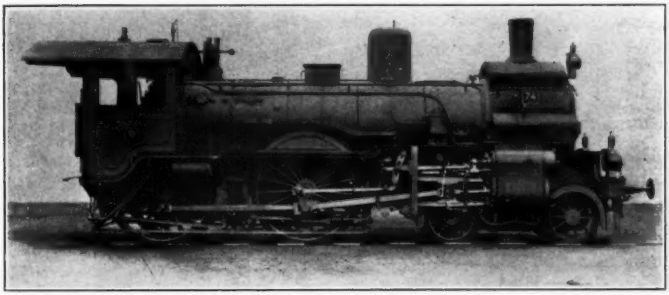
or retarding effect of an absolute head-wind is so small as to be virtually negligible, owing to the relatively small surface presented to it by an advancing locomotive, while the wind-cutters would present an *increased* surface of resistance to any wind at all on the side of the course, and would present the maximum of resisting surface to the worst wind of all—that blowing partly sideways and partly in front—I regard its effect as far more mischievous than beneficial.

Belgium exhibits a tank engine built for an English railway—the Barry line, of Wales—also three other tank engines of excellent construction, but of no special interest excepting one designed by Monsieur Bertrand, ingénieur-en-chef of the Belgian State Railway, and built by the Société de la Meuse. This bears a curiously close resemblance to the latest type of ten-wheeled tank engine designed by Mr. H. A. Ivatt, for the Great Northern Railway of England, having inside cylinders, four-coupled driving wheels, leading four-wheeled bogie, and a radial trailing axle. It is undoubtedly a very good and useful class of locomotive for heavy suburban traffic. Belgium also shows two very neat and compact six-coupled goods engines almost exactly similar, built for the Belgian State Railways. They follow so closely to the standard British type of "goods" or "freight" locomotive that no special notice is called for. Briefly they may be described as being each almost an exact replica of Mr. J. F. M'Intosh's standard type of goods engines used on the Caledonian line.

Switzerland shows some powerful locomotives designed for work on the steep gradients which prevail in that mountainous country. The four-cylinder, three-cylinder, and two-cylinder systems are all represented.

Some very large and massive Austrian engines are exhibited, chiefly of the two-cylinder compound—Gorlsdorf—type. A ten-wheeled express engine with six-coupled 6-foot wheels, 200 pounds steam pressure and a weight of 69 tons; a huge double-ended mogul-class goods weighing 70 tons, and a consolidation-class goods of 66 tons weight, are among the most noticeable.

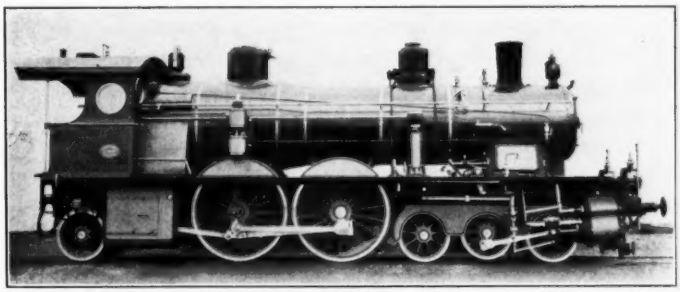
Among the Hungarian locomotives, a fine 7-foot coupled, two-cylinder compound express weighing 64 tons may be commended, but the most remarkable of the Hungarian exhibits is a double-four-coupled articulated Mallet compound goods engine which has each separate set of four-coupled wheels driven by its own pair of outside cylinders, one high-pressure and one low-pressure, one set being virtually a steam bogie, somewhat after the Fairlie method. A similar mode of construction occurs in one of the large Russian engines to



GERMAN EXPRESS ENGINE WITH STEAM SUPER-HEATER. A. BORSIG, BERLIN.

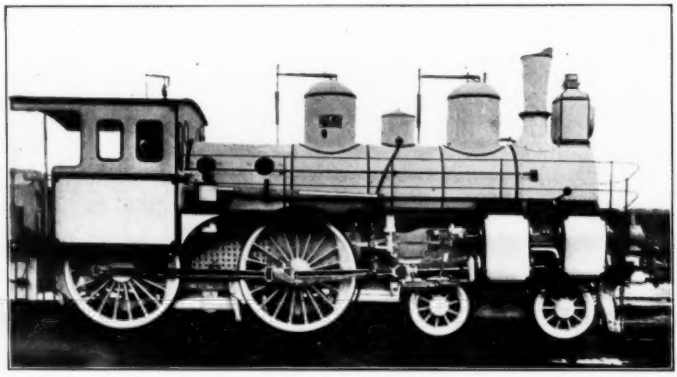
which I shall have occasion to refer directly. In the case of the Hungarian locomotive, it seems to me that this complicated plan of construction does not promise results at all commensurate with its costliness or compensatory as to its manifest drawbacks.

In the German section several interesting exhibits are to be found. A complex engine on the Klose system for working a rack-railway; a still more complex ten-wheeled tank engine, partly four-coupled and partly six-coupled—which would require a whole magazine-full of description to itself to make its design clear—the motion being transmitted from one set of coupled wheels to the other by an elaborate system (Hagan's) of rods, etc.; the peculiar Krauss engine with independent "donkey" assistant working between the two wheels of the leading bogie—referred to in my first article; another Krauss engine, a huge ten-wheeled four-coupled express weighing 68 tons, having a leading Bissel truck and a trailing four-wheeled bogie; and a fine four-coupled express by Borsig, with a steam super-heater appended to its smoke-box—all are notable and merit fuller notice than space permits me to bestow.



GERMAN EXPRESS ENGINE WITH OPTIONAL AUXILIARY MOTOR. KRAUSS COMPANY, MUNICH.

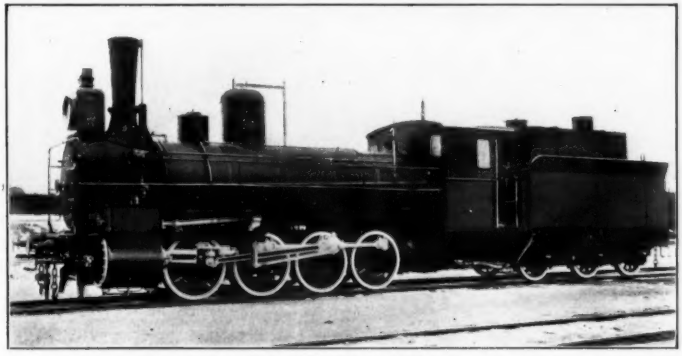
One of the two Italian exhibits, that shown by the Adriatic line, was noticed in my previous article. It is a four-cylinder compound, but in addition to the peculiarities already described it has this other one, that both its high-pressure cylinders are placed on one side and both its low-pressure on the other, contrary to the usual—and, in my opinion, preferable—practice of placing one high-pressure and one low-pressure on each side, while the cylindrical valve-chests give it the quaint appearance of possessing six cylinders. The second Italian engine is an extremely fine ten-wheeled six-coupled express locomotive with leading bogie; a two-cylinder compound with both cylinders outside, and coupled wheels 6 feet in diameter, belonging to the Mediterranean system.



LOCOMOTIVE FOR ST. PETERSBURG AND WARSAW RAILWAY, RUSSIAN GOVERNMENT LINES.

As to the Russian engines, it may be generally said that their vast size is their most striking feature. One is a "consolidation" goods, two-cylinder compound, weighing 65 tons and having a low-pressure cylinder no less than 29¼ inches in diameter, so that, as the eight coupled wheels are only 4 feet 1 inch in diameter, the cylinder-casing seems but slightly above the rail level. Another is a four-coupled express on the four-cylinder tandem-compound system. A third is a ten-wheeled two-cylinder-compound express with six-coupled drivers 6 feet in diameter, leading bogie, and outside cylinders. But the most remarkable Russian engine is the gigantic twelve-wheeled double-six-coupled duplex compound, on a modification of the Mallet system, and bearing the number H. 810. This is by far the biggest and heaviest engine in the whole Exhibition, weighing as it does 86 tons, and having a vast 46-ton tender appended; the total weight of engine and ten-

der being therefore no less than 132 tons, while the top of the chimney stands 16 feet 9 inches above the rail-level. This mighty locomotive is constructed on the articulated plan, the 4-foot driving wheels being coupled in two groups of six each, one being practically a steam bogie, while each group is driven by one high-pressure and one low-pressure cylinder, the respective diameters being 18¾ inches and 28 inches. In the case of this particular engine, more may be said on behalf of the complex system of articulation employed than in the case of the smaller but similar locomotive previously referred to. The Russian twelve-wheeler is intended for the haulage of immense loads and the ascent of steep grades. It is essential to the development of its full usefulness that it should be able to utilise its entire adhesive weight for traction, and that this weight should be distributed as widely as possible upon the rails without such distribution involving an undue length of rigid wheel-base. The plan adopted appears to satisfy these requirements in theory, at all events. How it works in actual regular practice I have not as yet had any opportunity of ascertaining.



ENGINE FOR THE RUSSIAN GOVERNMENT RAILWAY.

Summarising the Vincennes show of locomotives as a whole, I may say that there are 64 steam locomotives exhibited, of which 37 are compound and 27 non-compound. Of the former 18 have four cylinders, 16 have two, and one has three cylinders. In the total number of locomotives only one has single driving-wheels; 30 have four wheels coupled; 17 six wheels coupled; 4 eight wheels coupled, and 4 have articulated systems with the coupled wheels in two groups. All these are of the normal or the Russian gauge. There are also 8 engines for a gauge of one metre or narrower. In addition to the 64 steam locomotives, there are 3 electric

motors of various designs; several tramway engines and a large number of magnificent passenger-cars and goods-waggons. Within my present limits I must confine myself to the remark that of the different types of valve-gear in modern use the Walschaert is applied to no fewer than 44 of the 64 locomotives exhibited, the Stephenson to 10, and the Gooch to two.

My review would be incomplete did I neglect to notice one most extraordinary steam locomotive which is to be seen at the Paris Exhibition, but not among the others in the Vincennes Annex, specially appropriated to that object. It is the enormous express engine shown by Messrs. Schneider et Cie., of Creusot, France, as the central figure in their great display near the Eiffel tower. It runs on no fewer than *fourteen* wheels, four being coupled and 8 feet 3 inches in diameter. It has a leading four-wheeled bogie and a trailing six-wheeled bogie. The two cylinders, 20 inches by 27½ inches, are outside and drive the front pair of coupled wheels. The driver is provided with a wind-cutter cab in front of the smoke-box and can communicate by means of speaking tubes with the fireman, who occupies the footplate in the ordinary position. The engine alone weighs 81 tons; the total heating-surface is 3,250 square feet. The tender is enormous and runs on ten wheels, disposed in two bogies, one six-wheeled, one four-wheeled. Thus the engine and tender together run on twenty-four wheels. This tremendous machine, which is stated to have been built for swift "International Trains," was designed by Monsieur Thuille, who unfortunately lost his life during some preliminary experiments with his huge creation. The Schneider locomotive is undoubtedly a magnificent piece of mechanism, but I have been unable so far to discern its *raison d'être* or any satisfactory promise of such results as alone would justify what must be its excessive costliness. Also, it certainly appears to me deficient in constructive strength, but it would be premature at present to hazard any definite or final judgment upon a design so novel and as yet virtually untried in regular practice. It is, however, undoubtedly one of the most striking features in the French locomotive exhibition of the closing year of the nineteenth century.

NOTE.—In my previous article (September issue), Page 887, line 7 from foot of page, the printers have by mistake repeated the line which occurs four lines above. The sentence should have read as follows:—"Neither Mr. F. W. Webb nor Mr. Wilson Worsdell, the chief mechanical engineers of the only other British railways exhibiting at Vincennes, has ever built any single-wheelers at all for his line, although each has rebuilt and improved one class of single-wheeler left by his predecessor. Thus, as Mr. Pollitt, who built the new single-wheeler for the Great Central, has just retired from his position, and his successor's antecedents rather discourage the idea that he will perpetuate the type, it would appear that Mr. Johnson and Mr. Ivatt will be the only British engineers to continue building single-driver locomotives."

EDITORIAL COMMENT

If current reports are correct, November will witness an experiment in shipment of steel from Pittsburg to Liverpool which may have great meaning for the trade on both sides of the Atlantic. Four British steamers which have been trading between Canadian river and lake ports, it is said, are to load for home with 1,000 tons each of steel from the Carnegie works, taking on the freight at Conneaut, the terminus of the "Carnegie Company's railway," the Pittsburg, Bessemer, and Lake Erie. The ships thus laden to 14-feet draft will proceed by lake, river, and Welland and St. Lawrence canals to Montreal where they will complete loading with wood pulp and clear for home.

The motive of the attempt is the effort to avoid the alleged excessive freight from Pittsburg to the Atlantic seaboard. Talk of the independent railway line to tidewater, which Mr. Carnegie was said to be contemplating, has given way to rumours of a Carnegie line of freight steamers running between Conneaut, on Lake Erie, and European ports. The conditions do not seem highly favourable. The canals will not pass any but ships of comparatively small size and relatively low transport economy; navigation is slow and troublesome to Montreal, at least; the open season is short, probably not more than seven months; lastly, though it is a small factor, the Carnegie railway, we believe, is laid out particularly with a view to favouring traffic movement from Lake Erie to Pittsburg, and will not be quite so economically operated in moving goods the other way. However, the result of the experimental shipment will be observed with the utmost interest.

* * *

Progress of the anthracite-coal strike in Pennsylvania makes it more clearly apparent than ever that the establishment of unionism rather than the redress of any grievances is the chief end sought. The operators have offered an increase of wages to a figure which, as one commentator put it, "would make coal-miners' heads swim" in any other part of the world. The arbitrary charges for powder have been waived. Employers generally have expressed entire willingness to discuss or arbitrate any differences with their own workmen. But the strike goes on under the purpose of making the mine-owners "recognise" the United Mine Workers of America, and employers who are not chargeable with any of the abuses complained of are deserted by their men without a moment's consideration. The Markle collieries, where an arbitration agreement had been in force for years, were shut down with the rest; the men simply broke their pledge It was a "military necessity," the union leaders say, and probably the most telling example of labour's irresponsibility which has been exhibited of late. When the test comes the responsibility of labour melts into thin air. When the unions are in position to make enforceable contracts to furnish labourers on their agreed terms, they will command greater respect as negotiants.

* * *

A number of months ago we took occasion in these columns to call attention to the lack of a good technical dictionary, one which should really give the working equivalents of the terms used in engineering and technology in English, French, and German. The suggestion was then made that this work could best be accomplished by the co-operation of the various technical societies on both sides of the Atlantic, the definitions in each case be-

ing made or revised by experts in the languages of the several countries.

This matter has now been taken up by the *Verein deutscher Ingenieure*, and that society has undertaken the labouring oar in the work. Communications have been made by the German society to a number of other bodies, soliciting their aid in the good work, and there is every reason to believe that this important undertaking will be carried out with German thoroughness and success.

It is not only in the provision of the correct meanings of technical terms in the various languages that co-operation is required, since many expressions differ in meaning in England and the United States, so that some careful editing will be needed in that connection.

It is to be hoped that the responses from the different organisations which have been invited to join in the work will be favourable. A good beginning has been made by the American Society of Mechanical Engineers, which has decided to assist in the work to the extent asked by the German society—that is, to furnish the editors the names of specialists from whom accurate definitions may be obtained; and as the actual expense will be entirely assumed by the *Verein deutscher Ingenieure*, there is every reason for all the solicited societies to meet this generosity by the expenditure of only a little time and trouble.

It is most gratifying to find so prompt a response to the suggestion which, we believe, first originated in these columns, and we trust the good work will be carried to a prompt and satisfactory conclusion.

* * *

The laws of supply and demand may be depended upon to work out the solution of natural problems in one way or another, and when, as sometimes appears, the direct result is not practicable, some indirect development is later seen to be the result of unsuspected causes.

The rise in the price of coal really means a demand for more power, and the demand for power is gradually being solved by the extended utilisation of natural sources. A glance over the various reviews of the technical press of Europe and America elsewhere in this issue cannot but reveal the tremendous strides which are being made in the exploitation of water-power in various parts of the world. France especially has awakened to the vast resources available within her own territories, and Italy and Switzerland are not far behind. Costly black coal is to be offset with the power from the cheap "white coal," as the snows and glaciers of the Alps have well been named, and the work of the sun, stored in these masses of elevated water, unlike the earlier work of the same great source stored ages ago in coal, is constantly renewing itself, and cannot be wasted or exhausted.

England, indeed, has not the same sources of energy available as are in the possession of the continental competitors, but she has long been wasting vast quantities of energy from the tops of her blast furnaces which now, in the demand for power, will no longer be permitted to run to waste.

The whole question has become the immediate problem for the engineer, and he can be depended upon to solve it successfully.

When George III. visited the works of Boulton and Watt to see the building of the engines which were to add so much to England's prosperity, he was met by Matthew Boulton, who said:

"Your Majesty, we furnish here what all monarchs desire to possess—Power!"

REVIEW OF THE BRITISH PRESS

The Burden of Coal.

THERE has been much written and said of late about the changing conditions in the production, distribution, and use of coal, and for an excellent review of the whole situation reference may be made to an article by Mr. Benjamin Taylor, in a recent issue of the *Nineteenth Century*. Mr. Taylor well states at the start that the subject of coal is of national importance to every Englishman, because "not only is it a material indispensable to each individual's comfort, but also because our industrial prosperity and national greatness are inseparably bound up with it."

That coal has risen greatly in price, everyone knows, but just why it has risen at the present time, and whether the rise is permanent or temporary, is not entirely clear to everyone. Some maintain that the rise in price is due to the war in South Africa. This is true to a limited extent. It suspended the production of the South African coal mines, and it increased the demand for steam coal for the transports and troopships. Mr. Taylor shows that the coal exports for 1899 were 55,335,369 tons, as against 47,827,000 for 1898, and the first seven months of 1900 show a proportional increase.

The figures for 1900 so far also show, what is worth noticing, that, while there has been a general increase in coal exports, the quantity shipped for use of steamers in the foreign trade has decreased by 227,000 tons, which may be attributed to the larger supplies of cheaper American coal at the foreign stations.

The true cause of the scarcity of coal, however, is rightly stated by Mr. Taylor to be the increasing requirements for industrial purposes. Of these requirements by far the greatest are those due to the great demand for iron and steel. "A large part of our export of coal is, indeed, in the form of iron. Every ton of pig-iron smelted and exported represents the consumption of from two to two and a half tons of coal, and every ton of rolled iron and steel represents from six to eight tons of coal."

This being the case, it would seem as if there was no way of reducing the demand for coal without diminishing the demand for iron and steel, something surely not to be desired. If coal is to be saved only by restricting manufacturing industry and manacling shipping, small relief to the nation would be attained. To be sure there are other increasing uses for coal, the growing demand for power, the increase in electric traction, electric lighting, higher steamship and railway speeds. All these mean rapidly increasing demands for power, and its source, coal, which mean increasing prosperity, growing civilization, national progress; things certainly not to be checked if possible.

The question, therefore, is not how to restrict the demand, but rather how to meet it. Comparison at once is instituted with American coal, for last year the United States passed the United Kingdom in its output of coal, and is now the largest producer in the world. Not only is the United States the largest producer, but is also able to produce at a lower cost than any country in the world, excepting only India. "The best American steam coal is said to be, to all intents and purposes, as good as the best Welsh, and at the present moment it is less than half the price per ton at the port of shipment!"

In looking for the causes of this disparity in prices we have not far to seek. Briefly they are found in more accessible coal and a vastly greater output per person employed. It is a fact that in the American mines they can turn out 70 per cent. more coal per man in the year than in the British collieries. This is doubtless partly due to the increased efficiency of the men at the more moderate depths, and possibly also to the more general use of machinery.

Relief in the future for Great Britain, at least, must be looked for in various directions. First of all, high prices will enforce the necessity of economy in production, and especially in consumption. The use of the most economical boilers and engines may reduce the coal used for power nearly one-half, especially if power distributed electrically from central stations is substituted for very wasteful small engines and boilers. Metallurgical operations may be conducted with producer gas made from cheap, inferior coals, and with liquid fuels. The tremendous waste of power now permitted with the discharge of waste gases from blast furnaces will be stopped, the gas being converted directly into power in gas-engines, and the power electrically distributed. With these will probably come some imports of American coal, since the cost of transport will surely be reduced below the present rate.

"If a return current of raw coal from American in persistent volume is not probable, though not a commercial impossibility, a permanent current of consumed coal in the shape of iron and steel may surely be looked for. This will gradually effect an industrial revolution, as we shall have to find employment for our energies in manufactures not so dependent on cheap fuel. This may be looking a long way ahead, yet the conditions of the problem of the immediate future relate rather to the development of the coal resources of the United States than to the exhaustion of those of Great Britain."

Electric Stimulus.

VERY early in the history of the study of electricity the similarity between the electric phenomena and those of vital functions was observed, and the recent paper of Professor Chunder Bose before the British Association brings the result of his usual painstaking investigations toward new results bearing in the same direction.

Apparently Professor Bose has carried his study of Hertzian waves so far as to have demonstrated that these waves generate an electric stimulus by stressing the molecules of the material whatever its condition, whether in large or finely divided particles. The only difference is the depth to which the waves are able to act. In some cases an increase of resistance is produced, in other instances the reverse; some materials recover quickly, others slowly. The whole action is so analagous to that of living tissue as to demand the closest study of electricians and physiologists, and some of the conclusions may be very surprising. While it is hardly yet a subject for the engineer, yet it is difficult to say where the realm of engineering begins or where it ends, and all students of the science of force and controlled motion will at least find the paper of Professor Bose suggestive of thought and progress.

The Cost of Power Generation.

AMONG the various papers presented before the recent meeting of the British Association, that of Mr. J. B. C. Kershaw upon the comparative cost of various methods of power generation is of especial interest to engineers.

Except in special instances, the steam engine has long enjoyed supremacy as a prime mover, but its position is now assailed on two sides, on one by the revival of the use of water power, on the other by the various forms of internal combustion motors generically grouped under the title "gas-engine."

The remarkable increase in the use of water-power in Europe, and the investigations on the Continent having for their end the further utilization of this source, are reviewed at length elsewhere in this issue, and there is no need to emphasise the fact or discuss its commercial importance. On the other side, the development of the gas engine and the practical demonstrations which have been made of the successful construction and operation of large sizes, from 100 to 1,000 horse power, have raised this type of motor from its former comparatively unimportant position to the rank of a worthy and formidable competitor of the steam engine. In some cases the choice of a motive power is decided by extraneous considerations: the proximity to a water source, or to a coal field, determining the selection of water or steam power. "In the great number of cases, however, especially when the decision of the engineer covers the choice of a site for the factory, the problem is capable of no such easy solution, and the

most economical source of power can only be determined after an exhaustive study of comparative costs data. There has been an immense mass of information bearing on this subject published in recent years, but no attempts have been made to co-ordinate these facts and data, and comparison between them in their existing form is unproductive of any useful results."

Mr. Kershaw has certainly gleaned carefully from current technical literature, and endeavored so to arrange the data that they may be compared and studied. In view of the general practice of continuous running in hydraulic power plants he has converted the results into costs per year of 8,760 hours, the figures being classified according to locality, so that labour conditions and other local influences may be taken into consideration.

An important cause for variation in the cost, especially of water-power, is the wide variation in the capital outlay. In some cases very little expensive preliminary work is required, and the main cost is that of power-house equipment. In others there is a large expense for dams, canals, transport of materials, or concessions. The capital outlay per horse power ranges from £3 9s. 3d., at Vallorbes, and £84, at Lyons.

There is an equally wide variation in the charges to consumers, although in this case the variation is partly dependent upon the cost of distribution. In Norway, the price is £1 per electrical horse power per year of 8,760 hours; at Niagara, the average charge is £4 6s. 7d., although it is much higher delivered to small consumers in Buffalo.

In regard to steam power, the tables compiled by Mr. Kershaw shows that in America, for engines of more than 1,000 horse power, the costs are £6 2s. 6d. to £6 6s. 3d., while in Switzerland the lowest cost of steam power is given at £9 per year. In order to compete successfully with water power, steam power must be generated in bulk, when, with coal at 7s. per ton, Raworth estimates that a 50,000 horse power plant could produce power at a yearly cost of £3 14s. per horse power.

Turning now to gas power, much depends upon the source and character of the gas. The superior economy of gas engines over steam engines is especially marked with motors of moderate size, and it is not necessary to have the very largest sizes to secure the advantages of the high thermal efficiency. According to the estimate of Meyer, using blast furnace gas, an electrical horse power can be produced at a cost of £4 1s. 7d. per year, while an estimate for Mond producer gas puts the cost at £5. Taking the lowest estimated costs in each case, these checking well with the lowest actual costs in the cases of water and steam power, the following table gives the final conclusions:

Power.	Cost.	Country.
	£ s. d.	
Water	1— 5—5	Canada
Steam	4—18—8	England
Gas (furnace)	4— 1—7	Germany
Gas (producer)	5— 0—0	England

These figures support the opinion, now generally held, that water, when developed without excessive capital expenditure, is the cheapest source of mechanical or electrical energy. "When, however, the hydraulic engineering expenditure has been heavy, or when the power after generation has required to be transmitted over long distances, the margin between the relative costs of water and steam power is greatly narrowed, and in some cases disappears altogether.

"Electrical energy, generated by falling water, is costing more at Rheinfelden, at Zürich, and at Buffalo, than it would cost in South Lancashire, if generated by steam power in large units, and the margin between the actual charge for water power at Niagara, and the estimated cost of steam power in large generating stations in South Lancashire, is only 12s. 1d. per electrical horse-power year."

In regard to gas engines, the question of practicability may be regarded as settled, but it is still unsafe to prophesy upon their place in industrial development. "If they do not cost excessive sums for maintenance and repairs, large gas engines—in conjunction with coke ovens and blast furnaces—may entirely alter the present position of affairs, and new industries which at present are being established in the neighborhood of water-power stations may find themselves in severe competition with similar manufactures carried on in the coal

and iron districts of the older manufacturing countries.

"It has been calculated that 2,000,000 horse power is annually wasted in the gases issuing from the blast furnaces of the United Kingdom. If these waste gases could be industrially utilised in the manner suggested, we should to a large extent be compensated for our lack of natural water-power. But blast furnaces demand coke, and coal beds are exhaustible, so that even if this source of mechanical and electrical energy be tapped, it can only postpone, but not avert, the final triumph of the waterfall and of the turbine."

The Association Screw Gauge.

THE second report of the Screw-Gauge Committee of the British Association, published in the *Journal of the Society of Arts,* and in other publications, contains so much that is of interest to engineers that it should be read by all, and an abstract can by no means do the subject justice.

The main point of discussion was the matter of providing standard gauges for the B. A. threads because of the difficulty in making an accurate fit of the rounded ends. The method proposed to prevent this difficulty is that of avoiding it, perhaps the best solution of the problem. For very small screws, such as are used in watchmaker's work, and in which the rounding is so slight as to be almost inappreciable, no change is to be made, but for the larger sizes, known as instrument-maker's screws, the top of the thread is to be flat and with a clearance.

The conclusions of the report are as follows: For screws from No. 0 to No. 11, inclusive:

For Screws:—That the designating numbers, pitches, outside diameters, and the common angle of 47½ remain unchanged; but that the top and bottom of the thread shall be cylindrical, showing flats in section, and that the depth of the thread shall be increased by one-tenth of the pitch, the diameter of the solid core being, in consequence, diminished by one-fifth of the pitch.

For Nuts:—That the designating numbers, the pitches, the diameter of the clear holes, and the common angle of 47½ remain unchanged; but that the top and bottom of the thread shall be cylindrical, showing flats in section, and that the depth of the thread shall be increased by one-tenth of the pitch.

A table is given showing the dimensions of the modified screws, and much interesting information concerning the investigations and experiments which led to the conclusions.

The Iron and Steel Institute.

THE Presidential address of Professor Sir W. Roberts-Austen at the Paris meeting of the Iron and Steel Institute is filled with matter of the greatest interest, but from its length we can only make a few abstracts, and refer the interested reader to the full text, which appears in several of the technical papers of the month, and will doubtless appear in the *Journal* of the Institute.

The principal point emphasised in the work of the metallurgist is that the main characteristic of the metallurgical work of the century has shown the interdependence of minute quantities of matter on the masses of metal in which they are hidden. The century's work, has, moreover, to a great extent revealed the way in which the small quantities of added matter act, and it has been shown that they exert profound influences even in solid metals; the fact that certain varieties of steel are "solid solutions" is now accepted, and the recognition of molecular movements in solids has become familiar.

Reviewing the progress which has been made during the closing century in the metallurgy of iron and steel, Sir Roberts-Austen touches briefly on the work of Davy, Dumas, Sainte Claire-Deville, Berthollet, Regnault, le Chatelier, Bessemer, Siemens, Osmond, and many others. The successive advances which appeared in the working and using of iron and steel at the various international exhibitions were shown to be making points in the progress of the art. Taking the three periods between the exhibitions of 1855, 1867, 1878, and 1889, the progress in each may be indicated by the words, "novelty," "quantity," and "quality." Taking the period from the exposition of 1889 to the present, and the advance is best characterized by the single word "intensity."

Two distinct lines of work have been followed in the last decade in the develop-

ment of iron and steel. The first of these has been in the preparation of new alloys of iron; and the second in the study of the properties of iron and its alloys.

The alloys to which attention has been mainly called are those of iron with chromium, alloys with nickel, and alloys with manganese.

In all of these valuable properties have developed and practical applications made. In the coming century it may be that alloys with vanadium, uranium, molybdenum, and even glucinum may prove as important as those with the better-known metals.

The improved methods of investigation may be divided into those employing thermal measurement, for the study of the physical properties of iron and its alloys; and those which study the structure of iron and the grouping of the constituents in its alloys by the use of the microscope. Both have been extensively worked in England and France, and also in the United States and Germany, and the results have been altogether encouraging.

In closing the address Sir Roberts-Austen said:

"The part played in the industrial evolution of the world by iron and steel metallurgists will be evident to all. The fact that they have contributed with commensurate success to the advancement of pure science is less generally known, and I may well, therefore, devote a few words in conclusion to recording some instances which readily present themselves. The carburisation of iron offers the first case in which the diffusion of solids in solids was observed. The study conducted by metallurgists of the associations of carbon and iron affords the most complicated case yet known, and indeed the only one which has been worked out, of metallic solutions. It presents, however, a unique case of the importance of allotropy in connection with the metals. In 1,000 parts of steel, 997 parts, more or less, may be iron and the rest carbon, but the result of the union is a metal that is more widely used and has more varied attributes than any other. It would seem that Nature has enshrined in steel a series of her most complex secrets, which we must discover as a condition of our successful use of it.

"Metallurgists have carefully investigated, and conduct daily, operations of vast industrial importance, in which the presence of a third body enables either elementary bodies or compounds to react on each other. Habitually conducting operations at high temperatures, which often invert ordinary chemical reactions, has led to the acquisition of a mass of information as to the reactions that do occur, and the compounds that are formed under such conditions. Pyrometric records, have, moreover, enabled the equilibrium of the less fusible metals in their liquid as well as in their solid state to be studied—a branch of work which chemists generally have not been in a position to undertake. The necessity for submitting the physical and mechanical properties of iron and its alloys to rigorous tests, as a routine operation in works, has afforded a rich store of information as to the molecular constitution, not only of metals, but of matter generally. Metallurgists have to deal with cases in which a mass of metal is acted upon by added matter in proportions that are too minute to intervene directly by the formation of chemical compounds with the whole of the mass, while in some cases no compounds are formed. The influence of the atom must, therefore, be more or less directly exerted. Hence it is that we, who still conduct processes, the traditions of which came down to us from mythological times, have done our share in 'giving the old Greek atomism a modern and a higher consecration.'"

.The Iron and Steel Question.

THERE is no doubt that the iron and steel trade in England is a subject for serious discussion, and hence a recent editorial in *Engineering* is especially timely.

Naturally, the question is one of demand and supply, and the ship-builder and others on the side of the demand look for their supply where they can get it the cheapest, all other things being equal. The steel producer finds that fuel and labour are the controlling elements of cost of his product, and it is in these two items that he finds his strongest competition elsewhere, particularly in the United States.

"There coal is comparatively cheap, and labour enters into the cost of producing iron to much less extent than is the case

in this country, so that the wage is not a dominant factor. And thus it comes that American steel is now being imported in increasing quantities into the Clyde and Belfast yards."

In addition to the competition of American steel in the home market, comes the cessation of orders from other countries, notably Germany, and hence the reason for an inquiry into the state of the trade at the present time.

It is decidedly time that the false doctrine of restricting output in order to maintain prices should be refuted. It is a truism that such artificially maintained selling prices only encourage foreign producers and strengthen foreign competition. The true effort should be toward reducing the cost of production.

In order to show the true condition of the trade as regards American competition, the productions of the United States and Great Britain are plotted in the form of comparative diagrams. These diagrams, for which the reader is referred to the original paper, show that at the present time the output of pig iron in America is 40 per cent. greater than that of Great Britain, while the product of steel is more than twice as much!

"Even if there should be no further augmentation of this yearly output, its maintenance threatens our trade, for there is every reason to assume that the present abnormal demand in America cannot continue, and the fiscal conditions and control over the supply will enable American makers to sell in foreign markets at lower prices, while maintaining rates at home. Indeed, already there are large consignments of American pig iron being sent to the heart of the Scotch iron district."

As the situation now stands, the United States have the advantage of lower prime costs, largely due to the easily-won minerals, to their great bulk, and to the facilities for handling and transporting coal and ore. To these must be added the effective utilisation of mechanical appliances, and the reduction of middleman's profit, and from them must be deducted the charge of over-sea freight rates. These latter may overbalance the cost advantage in the immediate British market, but in colonial markets America must have the gain, geographical conditions often assisting. The truth of these conclusions is affirmed by the facts in regard to America's advance in foreign markets. In seven years the total exports of manufactures of all kinds from the United States have more than doubled; the exports of iron and steel have increased from £14,000,000, in 1898, to £24,000,000, in 1900, an increase of £10,000,000 in two years! The development in Germany is also a matter for consideration. It is an interesting fact that, although the whole of the steel for the Kaiser Wilhelm der Grosse came from Britain, the same shipbuilding company—the Vulcan Works, of Stettin—get all their steel this year from German works.

When the question is asked, What is to be done? the first thing is to arrive at a full realisation of the character and extent of the foreign competition, and to study the causes by which it has been brought about. "Foreign competition in iron and steel is a reality, and requires the careful consideration of workmen as well as—perhaps more than—employers, for the future demands a reduction in the prime cost of production of all constituent minerals and in steel manufactures as well, and this can only be achieved by the liberal provision of modern plant, and by the use of it to the fullest advantage possible."

American and British Blast-Furnace Practice.

At a time when American products of iron and steel are crowding British products in home and colonial markets, the paper of Mr. T. B. Rogerson, before the West of Scotland Iron and Steel Institution, is both appropriate and interesting.

In making the comparison, Mr. Rogerson is in a position to speak whereof he knows, since he has spent about eight months recently in the United States, visiting most of the large blast-furnace plants in the iron-making States, and being given excellent opportunity to observe American practice.

The high reputation of Scotch pig iron renders it especially appropriate that the Scotch furnaces should be selected by Mr. Rogerson for comparison with the American ones; and, in fact, with the exception of the fact that English furnaces use coke and the Scotch use raw coal, the Scotch

practice is fairly entitled to be considered representative British practice.

The Scotch furnaces are about 65 feet high and 15 to 17 feet diameter of bosh, and are worked at a blast pressure of from 5 to 6 pounds, the blast being heated to 1,100° F., to 1,300° F. in Cowper or Whitwell stoves, the hot-blast main being usually common to all the furnaces in a plant. The coal is handled in charging barrows, at the rate of one ton per barrow, being taken up a steam hoist to the top of furnace and dumped in by means of the ordinary bell and hopper arrangement. This is followed by the barrows containing the mixture of ore and limestone, all being hand-filled, the men doing about 60 tons per day each. The slag is taken away from these furnaces either by running it into holes in the slag fall and hauling the pieces away when set, or else the liquid slag is hauled away in tubs or ladles of 4 to 12 tons' capacity. The iron is run out of a tapping-hole into a sand bed and cast into pigs, and when cold is carried away by hand, broken, and deposited in trucks for conveyance to the steel works. The tuyeres are cooled by being made of coiled pipe through which water flows, while the slag tuyere is formed of two annular brass cones, with water space between. The blast tuyere is stopped with specially prepared clay, and the furnace must be thrown off blast to do this, but the brass tuyere is stopped with an iron plug, which can be done with the furnace on blast. The tapping hole is stopped by hand with specially prepared clay, and it generally takes about ten minutes to do this, the furnace being off blast during this time.

"English blast furnace practice is very similar to Scottish, except that coke is almost entirely the fuel, the labour, or form of filling, etc., being the same as in Scotland. In a few places, however, they use blast up to 8 and 10 pounds pressure, and have also apparatus for lifting the pig iron, either in the whole grid, and breaking it with a specially constructed machine, either hydraulic or steam, and delivering it sampled into railway wagons, or gathering it up into slings of about 2 tons, and delivering into wagons.

"With these few exceptions there are no labour-saving devices other than those which were in force thirty years ago in Great Britain." The maximum output of a British furnace is about 1,200 tons per week, with 10 pounds blast pressure.

In the United States the furnaces are much larger, the output per furnace greater and the cost of production lower than in Great Britain. The furnaces are from 80 to 100 feet high, and from 17 to 20 feet bosh, with 8 to 16 tuyeres. Hot blast stoves are used, but each furnace has its own outfit, so that the blast can be varied in each case as desired. The blowing engines are more powerful than in England, furnishing blast at a pressure of 10 to 18 pounds per square inch, and the more recent engines press up to 25 pounds, a single engine making blast sufficient to make 400 tons of pig iron per day.

The material is handled by machinery as much as possible. The charge is conveyed to the top of the furnace in specially designed buckets, holding about 4 tons, the bottom of the bucket fitting the top of the furnace bell in such a manner that the charge can be delivered into the furnace without the escape of any gas. The time required to take up the charge, deposit the contents, and bring the bucket back requires about two minutes, and the whole filling of the furnace, about 700 tons per day, is done by one hoist engineman and three men on the locomotive which hauls the charge to the furnace.

The slag is run off through a copper tuyere into ladles holding from 10 to 15 tons and taken away for deposit in liquid form in a convenient place. The iron comes in the ordinary way from the tapping hole, and is run into large ladles, and taken direct to the steel works or to the casting machines. The hole is stopped, after the cast is done, by the use of a mechanical appliance, so that neither in the case of the slag nor the iron is it necessary to shut off the blast.

The great makes of the American furnaces are due to the greater pressure of the blast, bringing the charge down very rapidly and causing quick smelting even with the large proportion of small rich ores used. When the output of the furnace is raised to 2,000 to 5,000 tons per week the questions of regular filling and the disposal of iron and slag present themselves. The result has been the replacement of the laborious

work of men by machinery, and by the introduction of the casting machine to deal with the quantity of molten metal that could not possibly be handled in sand beds at the furnace. The result has been a cheapening in the cost that, in connection with abundant ore and fuel, has enabled the American iron-making industry to reach its present commanding position and causes its competition to be felt everywhere.

It will not do for Great Britain to continue the use of obsolete methods and appliances. As Mr. Rogerson forcibly says: "Let every pig-iron making son of a blast furnace pull himself together and not be always hankering after things that his grandfather did. These things were good enough in their day, but these days have gone."

The Transport of American Coal to Europe.

In view of what has been written of late about the competition of American coal to markets now largely supplied from British sources, an editorial in a recent issue of *The Engineer* regarding the matter of transport is of interest.

"Coal as an article of export is by no means in the same category as manufactured iron and steel. By virtue of proximity to the fuel and ore deposits, advanced methods of manufacture, and low railroad charges to the seaboard, the United States are in a position to compete with European manufacturers of iron goods in spite of the many miles of ocean which separate it from most markets. But that distance must prove an effective bar to a foreign coal trade of any magnitude, save in exceptional times such as the present, at any rate, while the United Kingdom has supplies into which the Continent may dip so long as it chooses to pay the price. The freight of three or four dollars per ton makes all the difference between profitable and unprofitable business.

The question having been reduced to one of transport, it is interesting to note the manner in which the changed front of the problem is being attacked.

"It must be allowed that, having realised what is the great obstacle in the way of a foreign coal trade, the Americans are displaying characteristic energy in the endeavour to remove it. Is it possible, they are asking themselves, so to reduce the cost of carriage across the Atlantic as to afford reasonable hope of a steady profit on shipments? Freights on ordinary 'tramps' will be reduced later when the pressure for tonnage is relaxed, but by that time the cost of English coal on the Continent will also be lower; and, anyway, if the charge for carriage across the Atlantic by the existing type of vessel were reduced to the lowest point consistent with profit to the owners, the cost would still be appreciably above the margin desired. In this contingency there has arisen a demand for a special class of collier—'a vessel of large carrying capacity, low cost of construction, with sufficient engine power to steam seven or eight knots an hour, and give steerage way in all weathers, equipped with the best machinery for handling cargo, and with minimum requirements as to size of crew and consequent operating expenses—a vessel, in short, built specially for the export coal trade, and which will do for it what the tank steamer has done for petroleum, and the steam barge for the ore and coal trade of the Lakes.' It is believed that if the great coal-carrying railroads of Pennsylvania, Maryland and Virginia were equipped with a fleet of such vessels, and could give a through rate on coal from the mines to foreign ports the problem would be solved. It would at least be in a better way to be solved, but even then there would be doubts, because England possesses an enormous initial advantage. However, the American people believe that a big trade is possible, and aggressive preparations are being made by railroads, coal operators, shipowners, and shipbuilders, to say nothing of the speculator, who hopes to make a little out of the situation. The railroads interested are uniting for a reduction in the cost of carriage to seaboard, and for the provision of better terminal facilities; the Chesapeake and Ohio Coal Company, which controls the Newport News shipbuilding plant, proposes to construct a fleet of colliers, and the Baltimore and Ohio, among others, is talking about doing the same thing. The tank steamer saved the export petroleum trade to Europe. It will be interesting to see if the colliers—which, by the way, have yet to be built—create a foreign trade in coal."

The Iron Industry in the Urals.

In a recent issue of the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale* is given an extensive abstract of the very complete report made to the Russian Minister of Finance by Professor Mendeleeff upon the present state of metallurgy in the Ural mountains, with especial reference to the iron industry. In undertaking this important task, Professor Mendeleeff had the assistance of a number of trained specialists, but the various reports were edited by him, and the general report and conclusions are the personal work of the great Russian chemist and mineralogist.

The great mountainous barrier between Europe and Asia, known as the Urals, began to be considered as a metallurgical centre during the seventeenth century, and by the efforts of Demidoff, Strogonoff and others the former nomad population was largely replaced by Russian immigrants. At first the efforts of the miners were directed only toward the extraction of gold and copper, but the energy of Peter the Great directed the exploitation of the rich deposits of iron ore, the proximity of immense forests supplying ample fuel, and for a time the iron of the Ural became widely known for its purity. Subsequently, however, the industry was overshadowed by the gold mining, and it was not until after the enfranchisement of the serfs, and the development of the mining region of the Donetz in 1880, that the iron industry of the Urals became once more of importance.

At the same time, the development of the Ural district has not kept pace with that of the Donetz, and an examination of the causes of this difference forms an important portion of Professor Mendeleeff's report. Thus the mining operations in the Donetz district starting in 1883 had attained an output in 1888 of 5,000,000 poods (80,000 tons), at which time the Ural district produced 22,000,000 poods (338,000 tons). Ten years later, in 1898, the product of the Donetz was 61,000,000 poods (970,000 tons), while the Urals had reached only 41,000,000 poods (660,000 tons). The total product of iron in Russia during the same ten years had increased from 41,000 poods to 136,000,000 poods (2,190,000 tons).

Among the causes for the slower development of the Ural district Professor Mendeleeff names several which are doubtless susceptible of removal or relief. Apart from the difficulties of local transport, the question of fuel is important. In the Ural there are no coal mines suitable for iron making, and charcoal is not suitable for large output and modern intensified methods, while in the Donetz district coal is abundant. This, however, is by no means the principal cause for the slower development of the Ural district. The main reason is the energetic influence of private initiative, with its scientific and practical application of ample capital.

At the present time the demand for iron in Russia is increasing, and the native product does not meet the demand, there being extensive imports. Thus in 1898 the total consumption of iron in Russia was 193,000,000 poods (3,100,000 tons), while the home product was 136,000,000 poods (2,190,000 tons), the balance being imported.

The sole reason for importing any iron into Russia is the question of price, and with the rich deposits of ore in the Ural district there is every reason why iron should be made as cheaply in Russia as anywhere. The great difficulty lies in the primitive method of conducting the management of the industry. A portion of the territory is controlled and also operated by the government, and the balance is under control and operation of great estates following similar methods. According to M. Mendeleeff, the government furnaces constitute the principal obstacles to development. They produce very little iron, and yet they prevent free competition. The

future of the Ural depends upon the suppression of these works, which bring no revenue to the state, but are rather an expense. This is especially true of the central portion, in which the principal government mines are situated. In the northern and southern portions the metallurgical industries are in the hand of private parties, and there is a much more favorable state of affairs.

The conclusion of M. Mendeleeff's report is well worth quoting:

"If the government follows the necessary measure we have indicated we shall see the Urals in a position to furnish iron and steel for Europe and Asia at a price much lower than is now admitted in Europe."

In order to accomplish this result but two or three years are necessary; within five years, at least, the Ural should be able to furnish its products at a low price. This conviction is based upon the inexhaustible riches of the mines and forests of the district. The Kamorowsk mines alone contain more than 100 milliards of poods (1,612,000,000 tons) hematite ore, 50 per cent. pure. The ore is exposed to the surface, and the ground is covered with dense forest, the district being on the banks of the Larabia river and only 30 versts (20 miles) from the Avziano-Petrovsk furnaces of the Ural-Volga Company. This is but one of a number of deposits, and when the rich mineral ores of this district of the Russian empire are developed in accordance with modern business and scientific principles Russia will not only cease to become an importer of iron and steel, but will be in a position to control the markets of the rest of Europe and Asia.

The Hydraulic Power of the Rhone.

One of the far-reaching consequences of the application of electricity to the transmission and conversion of motive power is seen in the continual efforts which are made on every hand to utilise sources of water-power hitherto partially or wholly neglected. Formerly only such water powers were utilised as lay in immediate proximity to commercial and manufacturing centres, and even these were not employed to their full possibilities. To-day we hear continually of new schemes for the control of streams and rivers, and see these schemes successfully exploited, both technically and financially.

In a recent number of the *Memoires et Compte Rendu* of the Société des Ingénieurs Civils de France there is a communication by M. F. Bonnefond upon the hydraulic power available in the upper Rhone within the French boundary, which contains some valuable information.

As is well known, the Swiss Rhone is utilised very effectively, especially in the vicinity of Geneva, the lake there acting as a reservoir in a very effective manner. In the portion extending from Pyrimont to Fort de l'Ecluse, near the Swiss frontier, in a distance of only about 12 miles, there is a difference in level of 210 feet, with a discharge, during periods of low water, of 5,300 cubic feet per second. It follows that in this stretch of 12 miles there is available a minimum effective capacity of more than 100,000 horse power. If, instead of taking the minimum discharge of the river, we consider the mean flow available during 9 or 10 months in the year, it is perfectly safe to count upon the development of 200,000 horse power.

Of this power, 10,000 horse power are already utilised by an Anglo-Swiss company, while three other projects, under the auspices of French companies, are only awaiting the completion of the legislative formalities to begin constructive operations. Two of these schemes are comparatively simple. The first, at the "Passe de Malpertuis," utilises a fall of 35 to 40 feet at a point where the stream passes between rocky bluffs only about 160 feet apart, and by boring a tunnel of about 650 square feet cross section, and 6,000 feet long to an available point below on the river a total head of nearly 60 feet may be obtained, developing about 25,000 h.p. even in winter, when the flow is diminished because of the frozen condition of the glaciers.

The second project is similar, and is planned for the curve in the river known as the "Boucle du Rhône." Here the river is wider, and it will be necessary to construct a dam about 328 feet long and about 20 feet high. A tunnel starting immediately above the dam will carry about 5,000 cubic feet of water per second, for a distance of 4,600 feet, discharging into the stream at a

point near the village of Arlod, and securing a head of about 90 feet, with a development of 30,000 h.p.

The third undertaking demands rather more notice, as it involves more elaborate construction works. The location is at the "Pont de Gresin," a small bridge across the Rhone about 7 miles from the Swiss frontier and a short distance above Bellegarde. Here the river flows through a narrow gorge about 80 feet deep, with a mean depth at the bottom of 25 feet of water, the width of the upper part of the gorge being 75 to 80 feet. An eroded chasm in the side of the gorge provides a convenient situation for a power-house, there being an area of more than 200 feet wide and 1,200 feet long available, and by damming the stream a short distance above, a very effective power-plant can be erected.

The proposed construction of the dam is interesting, and is practically similar to that which has already been successfully applied at Bellegarde by the Anglo-Swiss Company. Instead of constructing a solid masonry foundation, a platform of iron beams is thrown across the gorge at the low-water level, and upon this is erected a solid masonry structure, forming the upper portion of the dam. This work can be rapidly and thoroughly done during the winter months, when the water is low. A number of iron beams are also placed in an inclined position, running down from the masonry structure into the river bed, forming a grating covering the space below the water level, and against this grating a mass of rubble stone work is heaped, forming an obstruction to the stream which quickly becomes filled with the drift and gravel brought down by the water. The upper portion of the dam is provided with an opening which can be closed to any necessary extent by movable weir-needles, and thus the water level above the dam controlled to any desired extent.

It is expected that this plant will be capable of developing 30,000 effective horse power, and it is planned to convert this into electric energy in the power-house by means of 15 polyphase generators of 2,000 h.p. each.

These three schemes are, therefore, definitely planned to utilize about 100,000 horse power, not only in electro-chemical and electro-metallurgical industries in the vicinity, but also to transmit power to existing and developed industries within a radius of 120 to 150 kilometres. According to careful estimates, it is stated that the average price of a horse power per year, operating 24 hours per day, will not exceed 50 francs, or about one-tenth the price of a steam horse power under similar conditions.

The Progress of the Simplon Tunnel.

THE appearance of the seventh quarterly report of the Jura-Simplon Railway enables the latest information of the progress of the work upon the Simplon tunnel to be obtained, and from an abstract in a recent issue of the *Schweizerische Bauzeitung* the following data of the present condition of this important work are taken:

The total length of the completed tunnel is to be 19,729 metres, or about twelve and a quarter miles, and of this distance there were completed in June, 5,644 metres; the penetration being 3,252 metres on the northern, or Brieg side of the mountain, and 2,392 metres on the Italian side at Iselle; so that about 28 per cent. of the boring is completed. These figures refer to actual penetration, but it must not be understood that they represent completed tunnel. In the first place, as is well known, there are two parallel tunnels being constructed, of which at first only one is to be made the full size for a single track railway, the other being used for ventilation, and ultimately enlarged to full size when the demands of traffic shall require a double way.

The smaller tunnel has been carried along nearly as far as the main boring, there being frequent cross-connections to enable the ventilation to be effected, this being all the more necessary because of the remarkable rise in temperature with the increasing penetration. Thus on the Swiss side the temperature at a distance of 2,800 metres from the entrance was 23.9° C., while at 3,200 metres it had increased to 26.8° C., a rise of 3 degrees in 400 metres. On the Italian side the temperature is still higher, having attained 33.5° C. at a penetration of 2,200 metres. These results are higher than were expected, previous experience having led the engineers to antici-

pate a maximum temperature of not more than 25° C.

When the tunnel is completed and opened for traffic it will be practicable to establish such a complete ventilation as to prevent discomfort from heat, but during the execution of the work it requires powerful ventilation through the auxiliary tunnel to relieve the workmen from the heat.

Valuable data are given in the report as to the quantity of rock removed per day, and the weight of dynamite for a given removal of material, while the general results of the work are tabulated in convenient form for reference.

Automobile Torpedoes.

SUBMARINE warfare is undoubtedly destined to play an important part in naval conflicts of the future, and improvements in the mechanical devices connected with this branch of fighting machines are naturally to be expected. While much interest attaches to the submarine boat, the older apparatus, the automobile torpedo, will undoubtedly continue to hold its place as a subject for study and experiment.

In a recent communication to *La Revue Technique*, M. H. Noalhat discusses the construction of the Whitehead and the Howell torpedoes, and then proceeds to describe the improved directing device of Obry, intended as an improvement on the Whitehead torpedo.

In order to understand the action of the Obry device, it is necessary to describe briefly the characteristic features of the Whitehead torpedo, this weapon now being used by nearly all European governments. The cigar shape of the torpedo is well-known, and in the Whitehead type it is propelled by two screw propellers on the same shaft, revolving in opposite directions, and driven by an engine operated by compressed air. The explosive charge is in the front, and the steering is provided for by two devices. The rudder for direction is fixed before the torpedo is launched, the adjustment being regulated according to the currents at the moment. The rudder controlling the immersion is movable, and is actuated by an auxiliary motor governed by the pressure due to the depth of immersion.

Notwithstanding the success which has been attained by the Whitehead torpedo, and its adoption by many governments, it has defects. Apart from its complication, and the delicate mechanism which it contains, it is subject to frequent initial deviations from the intended course, and in fact it is hardly possible to estimate the influence of currents with sufficient accuracy to permit a close adjustment of a fixed rudder.

The Howell torpedo, adopted by the United States government, differs from the Whitehead in the use of the stored energy in a rapidly revolving fly-wheel as a motive power, instead of a compressed-air motor. Experiments have shown that this torpedo has a much greater accuracy of direction than the Whitehead, and there is little doubt that this greater directional stability is due to the gyroscopic action of the heavy, rapidly revolving fly wheel.

In the Obry device the action of the gyroscope is not applied directly to steady the direction of the torpedo, but is used to control the steering apparatus, and thus correct any material deviation from the original line of launching.

It is well-known that a rapidly revolving wheel with a heavy rim possesses a strong tendency to remain in the plane in which it originally began to revolve. In the Obry device such a revolving wheel is placed in the rear portion of the body of the Whitehead torpedo, the wheel being suspended in double gimbal mountings, similar to that of a ship's compass, and started in rotation at the instant of the launching of the torpedo. Connected with this free gyroscope is an auxiliary motor, so arranged that it is thrown into action by any deviation of the torpedo from the original position, the gyroscope remaining in the original position and forming an abutment against which the connecting levers act.

The auxiliary motor, in turn, acts upon the rudder, and as soon as the torpedo has been brought into the original direction the action upon the rudder ceases until a new deviation occurs.

In practice this device has been found to improve the steering of the Whitehead torpedo very materially, the deviation from the original line of direction not being greater than 2.5 metres in a distance of 200 metres, or about 1 per cent.

The Influence of Railway Development.

THE influence of environment upon the development of the inhabitants of any locality is well known, and it is reasonable to assume that any important modification in surroundings and habits of life will be reflected in the development of a country. It is therefore interesting to examine the effect of such an important influence as that which the changes in transportation due to the introduction of railways have made. Under the suggestive title of "Countries, People, and Railways," a paper was recently presented by Herr von Mühlenfels before the German Railway Association, and published in *Glaser's Annalen*, showing the influence of railways in general upon various nations of the world.

This phase of railway economy was foreshadowed as long ago as the middle of the century by von Weber, who called attention to the results which might be expected from the more general intermingling of national characteristics with the increasing facilities for communication. During the last quarter of the closing century this fact has been especially manifested, and in the course of his paper Herr Von Mühlenfels enumerates the development of railways in the various countries of Europe, and shows how it has been accompanied with the general advance of nations.

One of the most impressive influences of railway development in Europe is found in the effect upon military methods, the transportation of troops and supplies by rail having metamorphosed the whole system of tactics. The semi-military organisation of the railway personnel, too, has had its influence upon other branches of commercial life, extending as it does into every department of industry.

Apart from the entrance of such a systematic and methodical organisation into the general life of a community, the railway has accomplished what may appear to be almost the contrary effect in the awakening influence which it has had upon quiet towns and villages, previously dependent upon ordinary highway and river traffic for their communication with the rest of the world. There is to-day in most countries no town of moderate size which is not kept in close and active touch with the doings of the rest of the world, while the man who has travelled a few hundred miles is no longer looked upon by the villager as a great explorer and adventurer, as in the early years of the century.

In addition to the effect upon existing towns, the railway is responsible for the development of what may practically be considered as new cities, these being mainly manufacturing centres situated in localities always favorable for industry, but dependent upon economical and rapid means of transport. Such cities as Manchester, Sheffield, and Birmingham could never have attained their present commanding positions without the railway, and it is a matter of history in England that the changes in parliamentary representation which have brought many communities to the front politically have been due to the changes in the distribution of population brought about by industrial changes for which railways are largely responsible.

Herr von Mühlenfels enumerates at length the progress of railways in various countries, naturally giving the predominance to Germany, and his whole paper is a valuable and interesting contribution to a feature in political economy of modern growth and one hardly given sufficient consideration by writers and students. It is, in fact, only one phase of the controlling influence which the work of the engineer is gaining over the whole conduct of individual and collective life, and counterparts could be found in many other lines of engineering work.

The Alps as a Source of Power.

SINCE 1897 there has been at work a commission, appointed by the French Minister of Public Works, investigating the hydraulic power capable of being developed by the entire Alpine region, including the water-sheds of France, Italy and Switzerland, and the report of this commission forms the most important contribution to the recent quarterly issue of the *Annales des Ponts et Chaussées.*

It is naturally difficult to make precise estimates of the actual amount of hydraulic power available, but the researches of the commission were facilitated by the statistics of various sections in which river and stream gaugings have been made from time to time, supplemented by their own observations. It is especially desirable that

some reliable investigations should be made at the present time, since many vague, unreliable, and exaggerated statements have been made upon what may really be called guesses rather than scientific estimates. Selecting from among these the most reliable, we find that it has been estimated that France possesses about 10,000,000 horse power, undeveloped; Italy, 2,640,000 horse power, and Switzerland, 582,833 horse power. As a matter of fact, there are now actually developed in each of these countries the following amounts, neglecting all installations smaller than 200 horse power; France, 113,364 horse power; Italy, 250,000 horse power, and Switzerland, 200,000 horse power.

In endeavoring to obtain more definite figures, the French commission have considered the Swiss method of investigation the most reliable, and with some modifications have recommended that this system be used, taking each basin in succession and examining the capacity of those surfaces which may properly be considered pluvial. This will involve the installation of numerous stations for the observation of rainfall, in a more complete manner than is possible with the existing meteorological observatories. Such special stations will necessarily be employed also in observing conditions of stream flow and the issue of flood warnings.

In considering the utilisation of the water as a source of power, due consideration must be given to the demands for purposes of agriculture and navigation. So far as the question of navigation is concerned, especially of the smaller streams, it is a matter of minor importance, while for the larger ones, such as the Rhone, the hydraulic-power works may also be utilised to improve the navigation. By the use of movable dams and a system of lateral canals, the river, with its estimated total capacity of 800,000 horse power, might be converted from an impetuous torrent into a veritable hydraulic staircase, and be rendered alike serviceable to navigation, agriculture and industry. The benefit of an ample supply of cheap power must also be of great benefit to agriculture, and assist in irrigation in manner not otherwise possible, so there is no reason why these important interests should be antagonistic.

After a careful examination of the whole subject, the commission adopted the following rule for the estimate of the hydraulic power obtainable for any given district: The flow of the streams under consideration is observed during the period of low water, being the three winter months; for the remaining nine months of the year the mean flow is taken. The low water flow, multiplied by three, is added to the mean flow multiplied by nine, and the sum is divided by twelve for the yearly mean. This flow is multiplied by the total available fall to obtain the power. The gross horse power is taken at 100 kilogrammetres per second (the so-called "Poncelet"), this leaving a margin of 25 per cent. for loss in conversion into effective horse power on the shaft. In all cases the volume of water required for local irrigation purposes must be deducted. As an example, this rule is shown applied to the department of Hautes Alpes, and the result is a mean value of about 500,000 horse power. Using the data at present available for the stream flow, the total power available in the ten departments comprising the French Alps is computed to be 3,000,000 horse power for the season of low water, and 5,000,000 horse power for the yearly mean flow.

An important section of the report is devoted to the question of the cost of the power thus available, although, as may be supposed, it is difficult to arrive at exact figures. Two conditions are given as tending to cheap cost of installation of hydraulic power plants. The head of water should be great, and the plant should be a large one. The advantages of a high head are analagous to those obtained by the use of electric currents of high voltage, the expense of pipes and of turbines are both reduced, and in most cases machines of higher efficiency are at the same time obtained. The advantage of generating a large amount of power in one station is true in this case, as in the general economy of large establishments for any purpose. The fixed charges are proportionally a much less amount of the whole than in smaller plants.

The cost of the power is made up of two elements; the interest on the cost, together with the depreciation of the plant, and the operating expense. This is only true when

the power is sold at the shaft of the turbine, and in the great majority of cases a certain charge must be added for transmission and distribution.

So far as the cost of installation is concerned, experience in France has shown that in no case does this fall below 100 francs per horse power, and in some cases it is much higher; a maximum may be taken at 300 francs. In Switzerland, where the costs are necessarily higher, it is held that a plant costing more than 1,000 francs per horse power cannot be operated at a profit, while in Italy, where coal is more expensive, the profitable limit is still higher. M. Blondel assumes that 8 per cent. is a proper charge for interest and depreciation, and that 2 per cent. is enough for operative charges, so that the net cost of the power on the shaft may be taken at 10 per cent. on the cost of installation.

Taking the cost of installation, for a large plant, at 100 francs per horse power, and again at 1,000 francs, the cost of power in each case for transmissions to various distances, is tabulated in the following manner:

	Installation cost 100 francs per h. p.	Installation cost 1,000 francs per h. p.
Gross h. p. on shaft	10 francs	100 francs
Electric h. p. at works—1.20 hydraulic h. p.	27 francs	135 francs
Electric h. p. at 20 to 50 km.—1.-50 hyd. h. p.	60 francs	195 francs
Electric h. p. at 20 to 50 km. incl. distribution—2 hydraulic h. p.	110 francs	290 francs

The report contains a vast amount of useful information concerning the possible applications of the vast amount of energy available in France, and also discusses at length questions of legislation which necessarily enter into problems involving such valuable property rights.

The Reliability of Steam Indicators.

THE prominence which has been given of late to the results of studies upon the experimental engine in the mechanical laboratory of the University of Liège under the direction of Professor Dwelshauvers-Dery lends especial interest to the paper by his former assistant, M. Georges Duchesne, in a recent issue of the *Revue de Mécanique*, upon the methods of testing the indicators used in the work.

The indicator is supposed and intended to record the pressure in the cylinder at every point in the stroke, and in order that this may be accurately done it is necesary that the abscissas of the digram be directly proportional to the path of the piston and that the ordinates be directly proportional to the pressures existing within the cylinder. If these conditions are not rigorously met in the instrument and its application, and it is practically impossible that they shall be so met, it is necessary to compute and apply proper corrections if very close deductions are to be drawn from the diagram. The manner in which the calibrations for these corrections were made in the laboratory at Liège, as described by M. Duchesne, form an interesting example of the care with which the investigations have there been conducted.

Considering first the reducing motion and its connection to the paper drums, in the experimental engine at Liège the reduction is made by the use of an eccentric on the engine shaft, this eccentric being set exactly in line with the main crank, and of such radius as to give the desired reduction. The motion of this eccentric is conveyed by rigid rods as near as practicable to the indicators, so that the connecting cords are not more than 10 centimetres long, and the effect of stretch is reduced to a minimum. In order to test the accuracy of the reducing method, a scale of the exact length of the stroke, divided into 1,000 parts, was attached to the guides and a vernier fixed to the cross-head, thus enabling the position of the piston at any point to be determined with great precision. By comparison of measurements thus made with points marked on the diagram, the accuracy of the reducing motion was shown to be of a very high degree.

The method of calibrating the springs was that of direct weighting. The indicator was exposed to the action of steam long enough to enable the parts to become hot, and was then clamped in an inverted position to a bracket, so that a rod could be inserted into the cylinder and press upon the piston. Equal weights were then successively placed upon the rod, and the com-

pression of the spring in each case marked upon the paper drum. The return of the spring upon the removal of the weights was also marked, and thus the extent and uniformity of the spring movement was tested. It will be noted that this test also included the correct proportionality of the multiplication by the parallel-motion levers, and hence gave a correct calibration of the transfer of the piston movement to the pencil point. The result of these tests showed that many springs were unsatisfactory, but that after many trials it was possible to select those which gave results within the permissible limits of error.

These points being determined, the remaining disturbances were those due to the weight of the moving parts, to the force necessary to provide the necessary acceleration of the mechanism of the instrument, and the resistance due to friction.

The influence of the weights of the various parts was determined by taking the actual weights and reducing them to their equivalent value referred to the axis of the cylinder, and in the case under consideration it was shown that apart from being of negligible magnitude, the action was constant in value and sign, and hence without influence upon the form of the diagram.

The action of acceleration is less simple, but may be plotted graphically, so that the magnitude and location of the maximum effect may be determined. Taking into account the varying velocity of the paper-drum, including the effect of the angularity of the connecting rod, the constructed diagram showed that the maximum effect of the acceleration in the particular case under consideration corresponded to only 0.0007 millimeter on the ordinate of the indicator diagram, this maximum occurring practically at the moment of admission, there being practically no influence during the period of compression.

The measurements for friction were made with the aid of a delicate balance, the spring being removed from the indicator and the piston, rod, and system of levers being suspended from the bottom of one scale-pan and the resistance to motion weighed by adding weights in the other pan until motion was produced. The maximum value for frictional resistance was found to be 50 grammes, corresponding to 1-5 of a millimeter on the ordinate of the indicator diagram.

The details of the methods by which these corrections were determined form an interesting study of the methods employed in the laboratory at Liège, and the account given by M. Duchesne is a valuable contribution to the practical side of scientific investigation in steam engineering.

Dirigible Balloons.

THE recent experiments of Count Zeppelin in attempting to direct and propel an air-ship of the balloon type against the wind, is taken as the occasion by Herr von Loessl, well-known for his theoretical studies in wind resistance, to discuss other attempts to solve the same problem. In a recent issue of the *Zeitschrift des Oesterr. Ingenieur und Architekten Vereines*, he reviews the work of Giffard, De Lôme, Hänlein, Tissandier, and especially of Renard and Krebs.

The subject is naturally one which depends mainly upon the exposed area of the balloon and the available surface which can be given to the guiding and propelling apparatus, and also includes the important question of motive power of light weight and large capacity. Herr von Loessl also calls attention to the important part which is borne by the method of attachment of the propelling and guiding machinery to the gas reservoir, lightness and stiffness both being essential, as well as strength.

The great difficulty is that of ability to stem even moderate winds, and nearly all the successful trials which have been made have taken place in still air or against very light winds. There has, however, been a continual improvement in this respect. The machines of Giffard and of De Lôme required 2 to 3 seconds to traverse a metre, while that of Renard and Krebs traveled 7 kilometres in 23 minutes, and the Zeppelin machine went 5 kilometres in 15 minutes, both machines thus making about 5 metres per second. These velocities are so much less than even moderate winds, however, that there appears to be small probability of practicable navigation of the air by this method. Herr von Loessl's paper is an interesting résumé of the present state of the art.

REVIEW OF THE AMERICAN PRESS

The Education of Railroad Men.

IN a recent paper before the Association of Railway Superintendents, Mr. Walter G. Berg discussed in a very interesting manner the question of the education of railroad men for subordinate positions of responsibility, more particularly with reference to employees of the bridge and building departments. There is a distinct difference between professions and trades, or callings, and the education appropriate to each possesses a corresponding difference. If such a difference is not made there will be a mistaken tendency to lower the professional education, in a mistaken attempt to make it come within the scope of the subordinate field of work.

"In place of dragging down the college course to meet the requirements of the middle class of railroad men, the aim should be to extend the college system still higher, broadening its scope by adding studies on such general subjects as history, law, finance, transportation, and operation of railroads, so that it will turn out thinkers and originators, men to guide and teach the masses, minds trained to cope with unknown factors and difficult problems, investigators and promoters in every branch of the railroad business."

This view is generally held by students of the science of education, but the question of the proper character of education for the subordinate positions has not been so carefully considered.

"That there are numbers of subordinate and yet important occupations on a railroad for which no preparatory education exists, is apparent to anyone familiar with railroading and educational institutions."

There are isolated attempts for elementary instruction, and various forms of night-schools, but no recognized national system of preparatory railroad schools for the lower grades of the railroad service.

It is manifestly impracticable to have the various railway employees leave their regular duties during the day to receive class-room instruction. The education, whatever it may be, should have been at least partially received before that stage in the career of the employee has been reached at all. The great point is the desirability in the training of the employee in the real fundamentals of his work, so that what he may learn thereafter may rest upon a proper foundation, regardless of the manner in which the later information is acquired. At the present time the laborer or helper on a bridge or building gang takes the place, not because he has any especial aptitude or ambition for the work, but simply because he wants the job. If he can get a slight advance in pay in some other department he drifts off, and so shifts about without any permanent basis or idea. Other workmen who have learned their trades through apprenticeship are good workmen, but their skill is limited to the especial class of work in which they have been trained.

How different this would be if a boy, on leaving public school, would select his future calling and study for a year or two with that in view. A knowledge, such as he could readily acquire in some special department, would make him gladly welcome in such work, and after acquiring the necessary mechanical skill and practical knowledge, he would be better qualified to be promoted and gradually given a responsible position with benefit to himself and the company.

Mr. Berg gives a detailed schedule of the subjects which he thinks could be taught to advantage in an elementary way in a railroad trade school, with especial reference to the department of bridges and buildings, and then proceeds to enunciate his ideas upon the general question of the education of future railroad officers and employees.

He maintains that:

"First: A clear division should be main-

tained between the higher and middle classes of railroad men, and the preliminary educational systems kept distinct and separated from each other.

"Second: The higher class, offering the material from which, as a rule, the future managers, professional men, and heads of departments will be drawn, should be provided for by special railway departments at existing colleges, and by adding general railway subjects to the present curriculum of the technical departments of colleges.

"Third: The middle class of railroad employees, comprising young men entering the railroad service in subordinate positions of all kinds, many of whom will some day fill the large number of responsible minor railroad positions of trust, should receive, after leaving the ordinary school course, a special short preliminary schooling adapted to the particular departmental work they expect to take up on entering a railroad shop or office. This special education will be obtained most advantageously in special railroad trade schools to be established wherever desirable and possible throughout the country, the curriculum to consist of a one-year 'Regular Course' divided into suitable departments. Further, an 'Advanced Course" covering a second year, for such scholars who desire and have the means and qualifications necessary to continue their studies to a more advanced point."

The general programme for such a school as is suggested by Mr. Berg is given in his paper, to which the reader is referred. While it seems rather full for the elementary training which it is intended to cover, and while it seems rather extensive for the limited time assumed to be available, yet it contains many good points, and is well worthy of examination. There can be little disagreement with the general contention that a sound fundamental training in general principles will make better employees out of subordinates than is possible in the absence of any such training, and that the opportunities for promotion would at the same time be vastly in favor of the employees so trained.

The Rating of Incandescent Lamps.

In the recent issue of the *Journal of the Franklin Institute,* Mr. Arthur J. Rowland discusses very fully some mistakes which are often made in the rating of the illuminating power of incandescent electric lamps. Most people go by the manufacturer's label, but as many manufacturing establishments go to the trouble of weighing what they buy, instead of depending upon the dealer's weights, so many people are beginning to find it advisable to have electric lamps tested before the photometer. Not only should the user of incandescent lamps know that the lamps he buys really possess the candle-power which is marked on them, but he needs to know how that candle-power is maintained, as well as many other things about the relation between the power consumed and the light emitted.

The modern method of lighting calls for a proper distribution of illumination rather than of lamps, and in every case attention should be given to the places where the light should really be concentrated. In the case of a library it is the table which needs to be brightly lighted; in a factory or mill the light must be on the machines or work, and must be very good there. In neither case is it necessary to have the whole room as brilliantly lighted as the special points.

In this distribution of light, Mr. Rowland emphasizes the importance of the use of the best portion of the lamp.

"The light from below the lamp—that from the tipped end—is the important and useful light in all practical cases. This is not only true in the specific cases cited, but where large electroliers with many lights are used as well; for in such cases the lamps are usually flared out, with axes at some angle approaching 45°, in which case high candle power from the tipped end and low from the sides of the lamp would contribute to a good even illumination of the room."

The influence of filament form on candle power is a matter on which Mr. Rowland lays much stress. Of the various forms now in use, he shows that the double coil filament, using two coils in one filament, the coils being near the tipped end of the bulb, gives by far the most effective and useful illumination. Tests with 16 candle-power lamps of the same maker, under similar conditions except as to form of filaments, demonstrated that the candle power was very different in various directions, and very differ-

ent in a given direction with difference in type of filament. It is a matter of surprise that so many people have been near the verge of this discovery, but that it has been passed by. A manufacturer of sign lamps advertises special lamps for this purpose with "all the light from the end," but does not seem to have thought that this would be the proper thing for standard lamps!

In discussing what a 16 candle-power lamp really should be, Mr. Rowland takes up the various photometric methods, and after showing their weak points he proceeds:

"What more rational, then, than to measure the lamp's candle-power looking in at the end? It is the light coming from the end which we make use of—which we are interested in. Then this is the light to measure, and that by which the lamp should be rated. Lamps measured thus are as comparable with each other as lamps measured any other way. The apparatus required to make the measurement would be very simple, for no rotating device would be required and the lamp need only be inserted in the socket without any care as to which side comes uppermost when its candle-power is determined, since the candle-power must always be read the same. Thus, readings of different observers would agree without respect to anything involved in the measurement except the standards used and the personal element, which never can be eliminated. Such a radical change of method, however sensible the change, could not be made without the sanction and support of some of the large associations of electrical engineers. In the meantime, however, for eventually this method must certainly come to be used, all *lamp users* should, in addition to a measurement of candle-power in the conventional way to check up the lamps purchased, take a reading of the useful light given out from the tip.

"A 16 candle-power lamp should be one giving 16 candle-power from the tipped end. The horizontal candle-power might be considerably less and be irregular in different directions without altering the real value of the lamp.

"An ideal 16 candle-power lamp would perhaps be one which measures 16 candle-power from the tipped end, had 16 candle-power as the mean horizontal candle-power, and was of nearly 16 candle-power mean spherical. Such a lamp could be turned into an position in an electrolier and still give an illumination equally as good as before, and as well distributed.

"In most lighting, also, the end of the lamp which has been called the tipped end all along, should be tipless. Hold a piece of white paper below an ordinary tipped lamp hung with the tip down, as it commonly is, and the reason is unnecessary to state. Variations in thickness of glass and shadow cast by the tip make lines of light and shade that spoil all the real value of the light produced.

"Since the making of such lamps as these is doubtless but a choice of filament form and arrangement, let us hope it will not be long until there are some ideal lamps available commercially."

Pumping Engine Economy.

TAKING as a text the tests of the Allis pumping engine at the Chestnut Hill Station, Boston, and the Nordberg engine at Wildwood, Pa., *Engineering News* recently gives a discussion of the question of pumping engine economy which contains a number of points of interest. Each of these engines has beaten all former records of engine performance, when measured by the only accurate method, the thermal-unit basis, and each of them has given a larger return in work done for a given amount of heat furnished by the fuel than was ever before given by a steam engine. The Allis engine gave a duty of 157,002,500 foot pounds per million B. T. U. in the steam furnished by the engine; the Nordberg 162,948,824 foot-pounds. If, however, we consider the economizer in the Allis plant as part of the engine instead of part of the boiler plant, which may fairly be done when we consider that the feed-water is heated in the Nordberg engine with steam taken from the receivers, then we have a duty of 163,925,300 foot-pounds for the Allis engine.

While the results are so nearly alike, the two engines are very different in design and operation. The Allis is a triple-expansion engine, the Nordberg a quadruple. The Allis runs at a speed of 17.2 revolutions per minute, and the Nordberg at 36.5. The Allis engine has one feed-water heater using ex-

haust steam, but relies chiefly on an economizer to heat its feed water; while the Nordberg has five heaters, one supplied with exhaust steam and the other four from the low-pressure cylinder and the three receivers. The Allis engine expands its steam about 42 times and the Nordberg about 24.

The coal consumption of the Nordberg engine plant is not given, but in the case of the Allis engine it is given as 1.062 pounds per i. h. p. hour. This appears to be the lowest figure obtained by any plant. It is nearly down to gas-engine practice with gas producers using anthracite coal or coke, and lower than the results for gas engines using gas from bituminous coal.

In suggesting where further economies might be effected, the writer shows that the substitution of a better coal might result in reducing the coal figure to 1 pound per horse-power-hour. Again, the economizer might be rendered more efficient. The figures of its performance show that it utilized only about 60 per cent. of the heat furnished to it. There was a further loss of heat during the test, due to cooling the drips from the separator, low-pressure jacket, and receiver, all of which might be saved by pumping the hot drips directly to the boiler.

"A still further reduction may be made by high superheating of the steam, which is now becoming quite common in Europe, but which American engine builders seem rather slow to adopt. With this improvement added, the fuel consumption of the plant may be brought down to, say, 0.90 pound per i. h. p. hour, and the duty raised to about 190 millions. All this without any change in the engine itself. It is not improbable, however, that the proportions or design of either the Allis or the Nordberg engine might be changed with advantage. There is a great difference between a triple expansion engine expanding 42 times, and a quadruple engine expanding only 24 times; and it is quite possible that a triple expanding 36 times and a quadruple expanding 42 times would each give a better record than the present engines."

It is well known, however, that the engine which uses the least fuel is not always the engine which uses the least money. The practical question in most cases where a large pumping engine is to be installed is not how great fuel economy can we reach, but how economical an engine will it pay to install? "Each case must be considered by itself, and in order to determine the most economical engine to install in a given place, the first cost of engines and boilers, the number of hours per year during which the engines are run, the rate of interest and depreciation, the cost of repairs, the cost of attendance, and the cost of fuel must all be taken into account."

In order to show the manner in which the various factors affect the general result, different prices for coal, and different rates of wages are assumed, and the results tabulated, the whole forming a very instructive exhibit of matters too often neglected by the theoretical engineer.

Moulding by Machinery.

THE use of moulding machines in the foundry is one which has had much discussion both in manufacturing and labor circles, and hence the paper of Mr. E. H. Mumford, recently presented before the Foundrymen's Association, is of more than usual interest.

Naturally there is more or less objection among skilled moulders at the advent of machines which enabled laborers to earn almost moulders' wages, and the old, old problem of the introduction of labor-saving machines is awakened anew with the improvements and use of such machines. There is no doubt that the moulding machine has come to stay, and that the real thing is to show the moulder that it is his friend and not his enemy, and that he will be better off with than without it.

Mr. Mumford states the old argument in favor of labor-saving machinery, but in such a concise and effective manner that it will well bear repeating.

"The general introduction of labor-saving machinery in the world of manufacture, while it has undoubtedly the (at least temporary) effect of displacing labor in the general field which it enters, yet increases rapidly the number employed in two other fields, namely: That where the machines are built and that which uses no machinery at all. That is, anything which facilitates the use of labor-saving machinery in general, as in the textile and agricultural in-

dustries—which the moulding machine obviously does, increases the number of men employed in making these machines. As the moulder, most naturally, is interested in the future of his trade, he should, therefore, do everything he can to encourage machine building in general, and nothing offers a better opportunity than leaving the moulding machine absolutely untrammelled in its natural progress with unskilled labor."

The present position of the Iron Moulders' Union is that the members should be allowed to develop the best possibilities of the machine and thus be able to "control" it. The best possibilities of the machine, like all other machines, will be developed by those who own them and who employ the men who operate them. It would be as useless for anyone to attempt to prevent the introduction of such machines as it would have been for machinists of earlier days to have prevented the introduction of the slide rest because it could be operated by men who had not the old-time skill with the hand tool. As Mr. Mumford well says: "The control of the moulding machine will never pass from the hands of the evolutionary destiny of the manufacturing world to either the moulder, the builder of the moulding machine, or its owner."

It would be an interesting matter to have the exact meaning of the term "skilled labor" examined at various periods of history, for it would assuredly be found that what was skilled at one period would be very crude at another. The real skill is not that of the mechanic, but of the man of genius, the artist, whose individuality is stamped upon his own work, a skill which he can only impart to those who, like himself, have the heaven sent gift of genius; or the skill of the mechanical genius, who can devise methods and apparatus for performing work which makes the skill of preceding times and men clumsy and crude by comparison, and sends tools and methods to the shelves of the mechanical museum and the pages of historical books.

Mr. Mumford enunciates five prominent facts, which show that the tardy trade of the moulder is gradually rising to the plane of the other departments of the machine works, despite attempts to retard progress by "controlling" machines and methods:

1. Moulding machines have entered upon a field of work in which they have proved their usefulness and economy, and in which they are destined to remain instruments of progress.

2. Machines dispense with some of the skill necessary to the moulder by the method of their working and render more of this skill unnecessary by avoiding some of the difficulties hand moulding introduces, such as mending broken corners, etc. They may therefore be successfully worked by unskilled laborers.

3. While laborers are perfectly well able to make machines profitable, in doing this they generally earn almost moulder's wages, when paid by the piece or when putting up a large day's work, and it is therefore possible for a moulder to do as well for the owner of the machine and for himself as the laborer does, if he will work as hard.

4. The moulder will not do as large a day's work as the laborer on a moulding machine for the same amount of money, and is therefore an expense to the owner of the machine he runs, similar to what would be the case if moulders were to charge the cupola, or run the cranes.

5. There is work enough for both the machine and moulder; and the machine, taking as it does, the repetition work, relieves him of the monotony which the general introduction of machines is accused of forcing on the wage-earning class as a whole, and owing to the speed and cheapness with which the machine turns out small parts, more of the larger and more intricate portions of machines are called for from the moulder.

American Pig-Iron Production.

THE commanding position which America has held in the pig iron market during 1899-1900, and the gradual return from the boom to normal conditions lends great value to the editorial résumé of the whole subject in a recent editorial in *Engineering News*. This paper has taken the weekly reports, furnished by the *Iron Age*, and by plotting them in the form of curves has enabled a general review of the production of the year to be very clearly seen. The curves include the latter portion of 1897, the whole of 1898 and 1899, and the first nine months of 1900, thus showing the in-

ception, growth, and recovery of the boom. The curves show the production of pig iron in gross tons per week, the number of furnaces in blast, and the prices, and from the beginning of 1899, the stocks of pig iron at furnaces.

It is difficult, without the diagrams, to show the fluctuations in products and prices, but it is interesting to observe that the output rose from 165,000 tons, in August, 1897, to 234,000 tons, in March, 1898, and to 298,000 tons in February, 1900. The prices in the meantime jumped from $9.35 to $10.40, to $24.90, but by September, 1900, the production had dropped to 223,000 tons, and the price to $14 per ton.

"Not only has production caught up to, and surpassed the demand, but the available furnace capacity is now far beyond any possible demand for the near future. It is now nearly eight months since the furnaces gave their maximum production of 298,000 tons per week, but during all this time many large furnaces have been under construction, and will be ready to blow in when the market warrants it. In the issue of *Engineering News* for November 9, 1899, there was published a list of nineteen large furnaces then building or projected, with an aggregate capacity estimated at 2,600,000 tons per annum, or about 20 per cent. of the then annual rate of production of the country.

"What of the future? Prices have now receded from the maximum of 150 per cent. above what may be called the normal price in ante-boom times of $10 per ton, to 40 per cent. above. Will they stay where they are for a while, or will they soon go lower? Judging from the state of the demand, and the accumulation of stocks, they should go to a much lower point than they have yet reached; but there are reasons for a contrary course. The cost of labor in all branches of the industry, and of freights by railroad and lake, is higher than it was in 1898, and this cost is not likely to be reduced at the present time, when the general business of the country is prospering. The slackened demand is not a normal demand; it is the demand of a waiting market, of customers afraid of a Presidential election, and of still lower prices. When buyers make up their minds that prices have touched bottom, buying will increase rapidly, and a steady and very large business will be done at reasonably steady prices. The boom is over; the reaction is come, but it will be of short duration, and the rebound will soon carry us back to good business conditions."

An interesting comparison is made with former booms, especially that of 1879-1880. Unlike the former boom, the present one has not shown the craze for speculation prevalent in 1879, when "privileges," "puts and calls," etc., on pig iron were dealt in by people who knew nothing whatever about pig iron, and when many fortunes were made and as many more lost by this form of gambling.

"The boom of 1899-1900 happily escaped this speculative feature, and the result was a steady market at maximum prices for six months, instead of a feverish market for only two months, as in 1880. There being less fever, the period of recovery has also been calmer. There have been no failures in the iron trade, and no great excitement.

"The whole history of the boom shows that it was only what might have been expected of a industry upon which general manufactures are so dependent, and which requires so much time to respond to a large demand. When it is considered how large an operation the construction and operation of a new blast furnace plant is, and when it is seen that the number of furnaces in the United States increased from 146 in the middle of 1897 to 293 in the middle of 1900, the reason for the rapid increase in price, and the steady maintenance, will be understood. It is indeed a healthy sign when such a great industry can respond to such a demand and maintain a sound business condition, ready either for steady requirements or for a great and rapid demand.

The Niagara Gorge Railway.

WHEN it was proposed to construct an electric railway in the gorge of the Niagara river, many persons felt that it would be a desecration of that magnificent piece of natural scenery, but now that five years of successful operation have elapsed, the paper of Mr. George A. Ricker, in a recent issue of the *Street Railway Journal*, is especially valuable as showing both the technical and æsthetical success of the work.

So far from being a defacement to the scenery, the gorge railway, like many of the Alpine rack railroads, is such an insignificant portion of the view that no appreciable impression is made by the tracks which hug the shelf at the foot of the great cliffs, winding their way beside the waters like toy tracks of children, with cars running slowly up and down, and looking like plaything trains.

During the construction of the road some landslides naturally followed the excavation of the talus, and bare spots were produced which were unsightly for a time. These are now fully covered with new vegetation, and any feeling that is had for the effect of the presence of the tracks and cars is fully overbalanced by the pleasure of the eager throngs that view the splendid panorama of the gorge from the vantage ground of the new road. Before the railroad was built but little could be seen of the wonderful spectacle. At a few points only could visitors get narrow glimpses of the tumbling waters, from stairways and crevices in the cliffs; now the whole river from the falls to Lewiston can be seen and enjoyed.

"Probably no more difficult railroad survey was ever attempted than this. The slopes, which from the uplands seem to be covered with soft verdure, and to present no great obstacles to progress, were found to be at close range almost impenetrable jungles of underbrush. Shrubs and trees in countless varieties were entertwined and bound together by the wild grape vines, grown to such density and strength as only the wild grape can, when undisturbed for many years. Much trouble was experienced in the insecure footing, as nicely balanced rocks of great size would roll down the slopes, crushing everything before, from the weight of a man climbing over them. The work of the survey was hazardous in the extreme, for not only was the vegetation dense and the footing insecure on the talus, but for a distance of about one-half mile below the railroad bridges, nearly vertical cliffs extended from the Highlands to the rapids below. At several points in this section men from the engineer corps were lowered over the cliffs and flags placed on projecting ledges where they might be seen from the top of the bank on the Canadian side. Base lines were established on Canada's side of the river, from which the flags were located by triangulation. Beyond this section, and continuing to Lewiston, the line was run following the curving bank of the river, and as nearly as possible 20 feet above the average water level."

This difficult survey work was naturally followed by difficult construction, and Mr. Ricker tells of many troubles which were experienced. No attempt was made at mathematical alignment, and the road bed follows the irregular outline of the natural slope. None of the curves are at all sharp for the slow rate of speed required by the schedule, and all that are less than 300 feet radius are protected by guard rails. In many places the road runs on a shelf blasted in the cliffs, and in others upon what is described as "enrockment." The whole is an example of difficult work well executed and thoroughly adapted to the unique conditions existing.

"Operation of the Niagara gorge railway, is continued from the first of May of each year to the first of March of the following year. March and April are the only months when the loose material from the cliffs falls upon the slopes of the talus. This is, of course, when the frost is coming out, and small stones which have been wedged out by the ice are loosened. Since beginning operation of the road in 1895 to the present time, no passenger or employee has ever received injury from falling rocks. With due care, and such is most certainly maintained by the present management, the maintenance of this railroad need not be excessively expensive, and that the same safety of operation can be obtained as is secured on any mountain railroad.

"Since the acquisition of the railroad at the top of the bank on the Canadian side by the International Traction Company and the reconstruction of the Suspension Bridge at Lewiston, a belt line has been in operation, over which cars of the Niagara Gorge Railroad Company pass, starting from Niagara Falls, and going to Lewiston by both railroads, making the trip down the Canadian side across the Suspension Bridge and up the Gorge; and also in the reverse direction. The extraordinary beauty of the scenery from the commanding heights on her Majesty's side of the river, combined with the grandeur and wondrous effects of

the rapids, which Hawthorne describes as 'an impetuous river of snow,' affords to the traveler an experience which is at once unique and impressive beyond power of words to describe.

"A new feature has been added to the attractions of the Gorge by illumination of the rapids at night. Trains are made up at the Falls, and run to the rapids, where an hour or more can be spent in contemplation of the beautiful spectacle. The lamps are hidden from view, and their rays projected over the waves by reflectors, so arranged that the illumination is most effective. Iin addition to the arcs, a large searchlight, mounted on a flat car, takes position some distance below the observation platforms, while its powerful beams are thrown against the waters and screens of green and yellow interposed, producing most beautiful effects. The roar of the waters against the walls of the Gorge, the depth of the canyon in the darkness of the night and the frowning cliffs above produce upon the onlooker a feeling of awe and fascination."

The Mouth of the Mississippi.

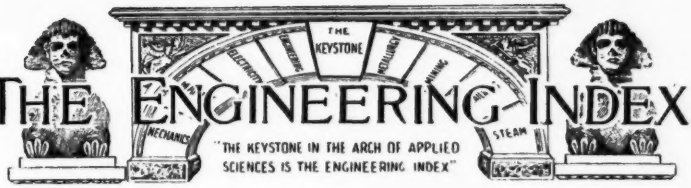
THE Mississippi river has always been a problem for the engineer, and there is every reason to believe that it will furnish him continual occupation for the future. The mouth, especially, or rather the mouths, have been the object of continual effort and activity, since the necessity of maintaining a navigable channel to the Gulf of Mexico is imperative. The famous jetties of Captain Eads provided a channel at the South Pass, and now there is a projected improvement of the Southwest Pass, discussed very fully and ably by Mr. William Starling in a recent issue of *Engineering News*.

Here it is proposed to provide a channel of 35 feet depth, and from a report made in 1898, by a board of engineers to Congress, the practicability of the plan was shown.

The plans provide for a combination of jetties and dredging, and with the experience had at the South Pass with the conditions to be met.

It is impossible here to give even an abstract of the very exhaustive paper of Mr. Starling, but it will be of interest to know that the cost of the projected works is estimated at $6,000,000, of which about $1,500,000 is for unforeseen contingencies, an indication of the uncertain character of such work.

The estimate of Mr. Corthell, that by 1948 the twenty largest steamships will average 1,000 feet long, 100 feet broad, and 43 feet deep, with a draught of 33 feet, shows how necessary it is for ports which desire to maintain their commerce to begin in time to deepen their entrances. Even in 1903 it is expected that vessels of 31 feet draught may be expected, and not only harbors, but docks as well, should be prepared to receive vessels of such dimensions. New York already has a channel 35 feet deep and 1,000 feet wide, and has under consideration one of 40 feet depth and 2,000 feet width, so that New Orleans is none too soon in the attempt to meet the coming conditions.



The object of this Index is to supply all persons interested in engineering and industrial pursuits with, first, an expert descriptive summary clearly indicating the character and purpose of the leading articles published currently in the established technical journals of the United States, Great Britain, and the Continent—in all languages; and, secondly, an inexpensive means of readily obtaining any portions of this literature that may be desired by our readers.

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THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED.

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the Index. In the list below, *w* indicates a weekly publication, *b-w*, a bi-weekly, *s-w*, a semi-weekly, *m*, a monthly, *b-m*, a bi-monthly, *qr*, a quarterly, *s-q*, semi-quarterly, etc. Other abbreviations used in the index are: Ill—Illustrated; W—Words; Anon—Anonymous.

American Architect. *w.* Boston, U. S. A.
American Electrician. *m.* New York.
Am. Engineer and Railroad Journal. *m.* New York.
American Gas Light Journal. *w.* New York.
American Geologist. *m.* Minneapolis, U. S. A.
American Jl. of Science. *m.* New Haven, U. S. A.
American Machinist. *w.* New York.
Am. Manufacturer and Iron World. w. Pittsburg, U. S. A.
American Shipbuilder. *w.* New York.
Annales des Pontes et Chaussées. *m.* Paris.
Architect. *w.* London.
Architectural Record. *qr.* New York.
Architectural Review. *s-q.* Boston, U. S. A.
Architect's and Builder's Magazine. *m.* New York.
Australian Mining Standard. *w.* Sydney.
Automobile Magazine. *m.* New York.
Automotor & Horseless Vehicle Jl. *m.* London.

Brick Builder. *m.* Boston, U S. A.
British Architect. *w.* London.
Brit. Columbia Mining Rec. *m.* Victoria, B. C.
Builder. *w.* London.
Bulletin Am. Iron and Steel Asso. *w.* Philadelphia, U. S. A.
Bulletin de la Société d'Encouragement. *m.* Paris.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bulletin of the Univ. of Wisconsin, Madison, U. S. A.
Bull. Int. Railway Congress. *m.* Brussels.

California Architect. *m.* San Francisco, U. S. A.
Canadian Architect. *m.* Toronto.

Canadian Electrical News. *m.* Toronto.
Canadian Engineer. *m.* Montreal.
Canadian Mining Review. *m.* Ottawa.
Chem. Met. Soc. of S. Africa. *m.* Johannesburg.
Colliery Guardian. *w.* London.
Compressed Air. *m.* New York.
Comptes Rendus de l'Acad. des Sciences. *w.* Paris.
Consular Reports. *m.* Washington.
Contemporary Review. *m.* London.
Deutsche Bauzeitung. *b-w.* Berlin.
Domestic Engineering. *m.* Chicago.
Eclairage Electrique. *w.* Paris.
Electrical Engineer. *w.* London.
Electrical Review. *w.* London.
Electrical Review. *w.* New York.
Electrical World and Engineer. *w.* New York.
Electrician. *w.* London.
Electricien. *w.* Paris.
Electricity. *w.* London.
Electricity. *w.* New York.
Elektrizität. *b-w.* Leipzig.
Elektrochemische Zeitschrift. *m.* Berlin.
Elektrotechnische Zeitschrift. *w.* Berlin.
Elettricita. *w.* Milan.
Engineer. *w.* London.
Engineer. *s-m.* Cleveland, U. S. A.
Engineers' Gazette. *m.* London.
Engineering. *w.* London.
Engineering and Mining Journal. *w.* New York.
Engineering Magazine. *m.* New York & London.
Engineering News *w.* New York.
Engineering Record. *w.* New York.
Eng. Soc. of Western Penn'a. *m.* Pittsburg, U. S. A.
Fire and Water. *w.* New York.
Foundry. *m.* Detroit.
Gas Engineers' Mag. *m.* Birmingham.
Gas World. *w.* London.
Génie Civil. *w.* Paris.
Gesundheits-Ingenieur. *s-m.* München.
Giorn. Dei Lav. Pubb. e d. Str. Ferr. *w.* Rome.
Glaser's Ann. f. Gewerbe & Bauwesen. *s-m.* Berlin.
Horseless Age. *m.* New York.
Ice and Refrigeration. *m.* New York.
Indian and Eastern Engineer. *m.* Calcutta.
Iron Age. *w.* New York.
Iron and Coal Trades Review. *w.* London.
Iron & Steel Trades Journal. *w.* London.
Iron Trade Review. *w.* Cleveland.
Journal Assn. Eng. Societies. *m.* Philadelphia, U. S. A.
Journal of Electricity. *m.* San Francisco.
Journal Franklin Institute. *m.* Philadelphia.
Journal of Gas Lighting *w.* London.
Journal Royal Inst. of Brit. Arch. *s-qr.* London.
Journal of Sanitary Institute. *qr.* London.
Journal of the Society of Arts. *w.* London.
Journal of U. S. Artillery. *b-m.* Fort Monroe, U. S. A.
Journal Western Soc. of Eng. *b-m.* Chicago.
Journal of Worcester Poly. Inst., Worcester, Mass.
L'Energie Electrique. *w.* Paris.
Locomotive. *m.* Hartford, U. S. A.
Locomotive Engineering. *m.* New York.
Machinery. *m.* London.
Machinery. *m.* New York.
Marine Engineering. *m.* New York.
Marine Review. *w.* Cleveland, U. S. A.
Metal Worker. *w.* New York.
Mem de la Soc. des Ing. Civils de France. *m.* Paris.
Mines and Minerals. *m.* Scranton, U. S. A.
Mining and Sci. Press. *w.* San Francisco, U. S. A.
Mining Reporter. *w.* Denver, U. S. A.
Mitt. aus d Kgl. Tech. Versuchsanst. Berlin.
Mittheilungen des Vereines für die Förderung des Local und Strassenbahnwesens. *m.* Vienna.
Modern Machinery. *m.* Chicago.
Moniteur des Architects. *m.* Paris.
Moniteur Industriel. *w.* Paris.
Municipal Engineering. *m.* Indianapolis, U. S. A.
National Builder. *m.* Chicago.
Nature. *w.* London.
Nature. *w.* Paris.
Nautical Gazette. *w.* New York.
New Zealand Mines Record. *m.* Wellington.
Nineteenth Century. *m.* London.
North American Review. *m.* New York.
Oest. Monatsschr. f. d. Oeff. Baudienst. *m.* Vienna.
Oest. Zeitschr. f. Berg- & Hüttenwesen. *w.* Vienna.
Ores and Metals. *w.* Denver, U. S. A.
Plumber and Decorator. *m.* London.
Popular Science Monthly. *m.* New York.
Power. *m.* New York.
Practical Engineer. *w.* London.
Pro. Am. Soc. Civil Engineers. *m.* New York
Proceedings Engineers' Club. *qr.* Philadelphia, U. S. A.
Proceedings St. Louis R'way Club, *m.* St. Louis, U. S. A.
Progressive Age. *s-m.* New York.
Railroad Car Journal. *m.* New York.
Railroad Gazette *w.* New York.
Railway Age. *w.* Chicago
Railway & Engineering Review *w.* Chicago.
Review of Reviews *m.* London & New York.
Revue de Mécanique. *m* Paris.
Revue Gen des Chemins de Fer. *m.* Paris.
Revue Technique *b-m.* Paris.
Revue Universelle des Mines *m.* Liége.
Rivista Marittima. *m* Rome.
Sanitary Plumber. *s-m.* New York
Schweizerische Bauzeitung. *w* Zürich.
Scientific American. *w.* New York.
Scientific Am. Supplement. *w.* New York.
Stahl und Eisen. *s-m.* Düsseldorf.
Stevens' Institute Indicator. *qr.* Hoboken, U. S. A.
Stone *m.* New York.
Street Railway Journal. *m.* New York.
Street Railway Review. *m.* Chicago.
Telephone Magazine. *m.* Chicago.
Tramway & Railway World. *m.* London.
Trans. Am. Ins. Electrical Eng. *m.* New York.
Trans. Am. Ins. of Mining Eng New York.
Trans. Am. Soc. of Civil Eng. *m.* New York
Trans. Am. Soc. of Heat & Ven. Eng. New York.
Trans. Am. Soc. Mech. Engineers. New York
Trans. Inst. of Engrs. & Shipbuilders in Scotland, Glasgow.
Transport. *w.* London.
Western Electrician *w.* Chicago.
Wiener Bauindustrie Zeitung. *w.* Vienna
Yacht. *w.* Paris.
Zeitschr. d. Oest. Ing. u. Arch. Ver. *w.* Vienna.
Zeitschr. d. Ver. Deutscher Ing. *w.* Berlin.
Zeitschrift für Elektrochemie. *w.* Halle a. S.
Zeitschrift für Elektrotechnik. *s-m.* Halle a. S.

ARCHITECTURAL ENGINEERING

CONSTRUCTION.

Baths.

The Francis Joseph Jubilee Baths at Reichenberg (Kaiser Franz Josefs Jubiläumsbad in Reichenberg). P. P. Brang. With elevation, plans and section of these fine new public baths in Austria. 2000 w. Zeitschr Oesterr Ing u Arch Ver—Aug. 10, 1900. No. 36619 B.

Chimneys.

Points on Chimneys. J. L. Bixby, Jr. Considers draft pressure, gauges, materials, etc., in part first. Ill. 2500 w. Met Work—Sept. 15, 1900. Serial. 1st part. No. 36396.

Earthquake-Proof.

The Construction of Earthquake-Proof Modern Buildings. Report of Earthquake Investigation Committee, Japan. Ill. 1400 w. Am Arch—Sept. 1, 1900. No. 36254.

Exposition.

The Schneider Pavilion at Paris. An illustrated description showing the numerous conditions that had to be fulfilled and the way the work was carried out. 3000 w. Engng—Aug. 24, 1900. No. 36238 A.

Fire Protection.

Fire Hazards. H. de B. Parsons. Discussing the effect of design and construction on the risk of fire, and the materials that best resist a conflagration. 6500 w. Jour Fr Inst—Sept., 1900. No. 36288 D.

Foundations.

The Manhattan Railway Power-House Foundations. Illustrated description of the very heavy concrete foundations for a 431 x 204-ft. station to develop about 100,000 H. P. 2000 w. Eng Rec—Sept. 8, 1900. No. 36306.

Ice-Making.

Building for a Large Ice-Making Plant. Illustrated description of a 5-story structure about 200 ft. square, consisting of a machine house, freezing house and boiler house, and containing many unusual details in the steel work. The coal and ash pockets are described very fully. 2800 w. Eng Rec—Sept. 8, 1900. No. 36305.

Underground Chambers.

The Construction of Moisture-Proof Underground Chambers. L. R. Grabill. Discusses methods and gives plan and description of an underground dynamo-room of moisture-proof construction. 1500 w. Eng News—Sept. 6, 1900. No. 36319.

HEATING AND VENTILATION.

Club House.

Lighting, Heating and Ventilating a Club House. Illustrated description of changes made at the Whist Club of New York. 2000 w. Met Work—Sept. 8, 1900. No. 36300.

Dormitories.

Ventilation and Heating of the University of Pennsylvania Dormitories. Illustrated description of the methods of heating a large number of small rooms and ventilating them by the plenum system. 1800 w. Eng Rec—Sept. 8, 1900. No. 36307.

Moisture.

Moisture in the Air of Rooms. J. H. Kinealy. From *Heating, Ventilating and Sanitary Plumbing.* The sources of moisture, the amount, etc., are discussed. 3800 w. Pro Age—Sept. 1, 1900. No. 36210.

Steam Heating.

Pressure Regulator, on the Eggert System (Druckregler, System Eggert). An illustrated description of a pressure regulator for steam-heating plants. 1200 w. Gesundh Ing—July 15, 1900. No. 36559 B.

CIVIL ENGINEERING

BRIDGES.

Alexander III.

The Cast-Steel Construction of the Alexander III. Bridge in Paris (Die Stahlformguss-Constructionen der Alexanderbrucke in Paris). Inspector Frahm. Giving especial attention to the moulding and casting of the steel voussoirs. Two articles. 7500 w. Stahl und Eisen—Sept. 1, 15, 1900. No. 36649 each D.

Arches.

Arch Construction for Railroads. From a paper by J. W. Rollins, Jr., before the New England Railroad Club, with illustrations. Serial. 1st part. 1300 w. Ry & Eng Rev—Sept. 22, 1900. No. 36831.

Bracing.

Diagonal Bracing Over the Turntable in Swing Bridges. Malverd A. Howe. Mathematical discussion of the stresses in

a case of balanced loading. 1000 w. R R Gaz—Aug. 31, 1900. No. 36184.

Drawbridge.

The Maumee River Drawbridge. Illustrated description of a bridge having a center pivot of unusual design and special end lifting devices. 1000 w. Eng Rec—Sept. 8, 1900. No. 36303.

Lattice.

Shipping and Erecting a Complete 130-Foot Railroad Span. Illustrated description of the method of shipping a single track lattice girder span with trusses 14 ft. 9 in. deep and 10 ft. apart. 1000 w. Eng Rec—Sept. 1, 1900. No. 36197.

Moselle.

The Bridge Over the Moselle Between Trarbach and Traben (Die Moselbrücke bei Trarbach-Traben). A very completely illustrated account of the new highway bridge over the Moselle. Five braced bowstring trusses of 54 to 64 metres span. Two articles. 3500 w. Glaser's Annalen —Sept. 1, 15, 1900. No. 36656 each D.

Niagara.

Rebuilding Niagara's Reservation Bridges. A general account of the new concrete bridges between the mainland, Green Island and Goat Island, with illustrations of perliminary construction. 700 w. Sci Am—Sept. 22, 1900. No. 36583.

Norval's Pont.

The Reconstruction of Norval's Pont Bridge. Some good illustrations of the bridge before and after reconstruction. 250 w. Engng—Sept. 7, 1900. No. 36453 A.

Paris Exhibition.

Railways and Bridges at the Paris Exhibition. Brief descriptions of interesting engineering construction. 4000 w. Builder—Aug. 25, 1900. No. 36233 A.

Pontoon.

Pontoon Swing Bridges Over the River Weaver, at Northwich, England. John A. Saner. Abstract of a paper before the Institution of Civil Engineers, describing a swing span supported upon a circular steel pontoon, with various interesting details. 1 plate. 5000 w. Eng News—Sept. 20, 1900. No. 36546.

Viaur Viaduct.

The 721-ft. Three-Hinged Steel Arch Railway Bridge Across the River Viaur, France. Illustrated detailed description of one of the most notable metal arch bridges of recent years. 4000 w. Eng News—Sept. 6, 1900. No. 36316.

CONSTRUCTION.

Arches.

Notes on Foundation Arches (Einiges über Grundbogen). A. Francke. A mathematical study of inverted arches as used for masonry foundations. 2000 w. Schweizerische Bauzeitung—Aug. 25, 1900. No. 36666 B.

Foundations.

A Novel French Method of Making Foundations in Soft Ground. A description of a method invented by Messrs. Dulac and Ducloux, in which a hole is driven in soft ground by a falling weight, and filled in with hard material. 1100 w. Eng News—Sept. 27, 1900. No. 36844.

Foundations of the Alliance Building. Illustrated description of the method of sinking 100 pneumatic caissons for the foundations of a building covering 27,000 sq. ft. ground area; also illustrates the steel grillages and wind bracing. 2700 w. Eng Rec—Sept. 22, 1900. No. 36709.

Reinforced Concrete.

Reservoir of 3,000 Cubic Metres Capacity in Reinforced Concrete (Reservoir de 3,000 Mètres Cubes de Capacité en Ciment Armé). Illustrated description of a reservoir at Waalheim, in Belgium, constructed with concrete reinforced by expanded metal. Full details are given. 1200 w. Revue Technique—Sept. 10, 1900. No. 36616 D.

Theory and Applications of Concrete-Iron Construction (Anwendung und Theorie der Betoneisen Konstruktionen). Josef Rosshänder. A general examination of the various methods of reinforcing concrete by means of imbedded metal. Serial. Part 1. 1800 w. Schweizerische Bauzeitung—Sept. 8, 1900. No. 36667 B.

The Use of Expanded Metal in Concrete Construction. From a paper before the British Association by A. T. Walmisley, giving theoretical considerations and also the results of trials. 1800 w. Gas Wld—Sept. 15. 1900. No. 36792 A.

HYDRAULIC AND WATER SUPPLY.

Canal.

The Completion of the Marne-Saone Canal (L'Achèvement du Canal de la Marne à la Saone). G. Leugny. With map and sections of various portions of the canal, and a table showing the shortening in route effected. 3500 w. Revue Technique—Aug. 10, 1900. No. 36612 D.

Canal Haulage.

See Electrical Engineering, Power Applications.

Causeway.

Hydraulic Causeway Construction. Describes a long road over the marshes of Jamaica Bay, built up with sand and mud obtained by hydraulic dredging and deposited between banks of turf. 1900 w. Eng Rec—Sept. 22, 1900. No. 36706.

Coast Protection.

Sea Coast Destruction and Littoral Drift. W. H. Wheeler. States the conditions that have caused the present state

of the cliffs and coasts, and the conditions under which the material is drifted along the shore, illustrating by a study of the coast of the south-west of England. 3400 w. Nature—Aug. 23, 1900. No. 36227 A.

Columbus, O.

Columbus and Its Water-Works. Historical account, with illustrations of pumping station. 1600 w. Fire & Water—Sept. 1, 1900. No. 36266.

Dam.

The Wachusett Dam for the Metropolitan Water Supply, Boston, Mass. Alfred D. Flinn. An elaborately illustrated description of the proposed great masonry dam, with selected passages from the specifications. 1 plate. 8000 w. Eng News—Sept. 13, 1900. No. 36419.

The Wachusett Dam. Illustrated description of a masonry dam of unusually heavy section, over 200 ft. high, for the Metropolitan Water Board of Massachusetts. The first part describes the site, the character of the masonry and the gate chambers. 3900 w. Eng Rec—Sept. 8, 1900. Serial. 1st part. No. 36302.

Dredging.

Dredges (Les Dragues). R. Masse. The first instalment of a treatise on dredging machinery. Part first treats of suction dredges. 3500 w. Revue de Mécanique—Aug., 1900. No. 36641 H.

Dredge for Calcutta. Describes the first of four dredges for use at the Kidderpore docks, Calcutta, and in improving the canal between the Baltic Sea and the Volga River. 1000 w. U. S. Cons Repts, No. 833—Sept. 14, 1900. No. 36389 D.

Hopper Dredger "La Puissante." A well illustrated description of the largest dredger of the stern-well bucket type, built in England for the Suez Canal Company. 900 w. Engr, Lond—Sept. 7, 1900. No. 36464 A.

Hydraulic Hopper Dredges for the East Channel, New York Harbor. Illustrated description of the "Thomas" and "Mills," each 300 feet long, 52½ feet wide and carrying 7,000 tons. 1500 w. Eng Rec—Sept. 22, 1900. No. 36705.

Dry Dock.

Flooding of the New Dry Dock Excavation at the Boston Navy Yard. Frank O. Maxson. Illustrated description of the sliding of a large area in consequence of excavation behind the coffer dam. 2800 w. Eng Rec—Sept. 22, 1900. No. 36707.

Filters.

On American Filters and Filtration Methods, Particularly on the Rapid Filter (Ueber Amerikanische Filter und Filter-Methoden, insbesondere über die Schnell-Wasserfilter). Wm. Paul Gerhard. A general review of American methods of filtering water for city purposes on a large scale. Serial. 1st part. 1800 w. Gesundh Ing—July 15, 1900. No. 36557 B.

Flow of Water.

Experiments on the Flow of Water Over Dams. Abstract of a graduation thesis by A. H. Greenwood, L. S. Oakes and J. L. Sanborn, at the Thayer School of Civil Engineering, giving the results of experiments, with models of several well-known dams. Illustrated. 2900 w. Eng News—Sept. 27, 1900. No. 36843.

Gatehouse.

Spruce Lake Gatehouse. Illustrated description of a gatehouse at St. John, N. B. 1200 w. Fire & Water—Sept. 8, 1900. No. 36352.

German Waterways.

The Interior Navigation of Germany (La Navigation Intérieure de l'Allemagne). A review of the internal waterway system of Germany. 1100 w. Moniteur Industriel—July 14, 1900. No. 36837 E.

Holyoke.

The Water Power at Holyoke, Massachusetts. Horatio A. Foster. Paper before the Engineers' Society of Western New York, giving an illustrated account, historical, technical and financial, of this water power on the Connecticut River. 5400 w. Jour Assn of Engng Socs—Aug., 1900. No. 36531 C.

Irrigation.

Irrigation in Idaho. Brief review of the work that has been done, with illustrations. 800 w. Sci Am—Sept. 8, 1900. No. 36313.

Lighthouses.

French Lighthouses at the Paris Exposition (Les Phares Français à l'Exposition de 1900). A review of French modern practice as illustrated at the Exposition. 1100 w. Moniteur Industriel—July 28, 1900. No. 36839 E.

Lights on Lake Erie. An interesting communication from Col. Wm. Anderson, of Ottawa, relative to a new plan of lighting Pelee Passage. 700 w. Marine Rev—Aug. 30, 1900. No. 36207.

Mississippi.

High-Water Protection Methods on Lower Mississippi River. Wm. J. Hardee. Paper before the Louisiana Engineering Society, containing a discussion of the levee system and suggestions for improvements. 9500 w. Jour Assn of Engng Socs—Aug., 1900. No. 36532 C.

Reservoirs and the Control of the Lower Mississippi. James A. Seddon. A consideration of drainage systems and their combinations, with their problems, giving a summary of twenty years' experience. Also discussion. Plates. 31000 w. Jour W. Soc of Engs—Aug., 1900. No. 36292 D.

The Problem at the Mouth of the Mississippi River. Advocates the improvement of Southwest Pass rather than South Pass. 1200 w. Eng Rec—Sept. 15, 1900. No. 36414.

New England Association.

Annual Convention of the New England Water-Works Association. Abstracts of papers read at Rutland, Vt. 1500 w. Eng News—Sept. 27, 1900. No. 36853.

Ozonization.

The Ozonization of Water. Geo. A. Soper. Paper giving results of practical experience, with discussion. 7000 w. Jour N Eng Water Works Assn—Sept., 1900. No. 36533 D.

Pipe.

A Few Notes on Cast-Iron Pipe. F. C. Coffin. Paper giving various practical points, with illustration of a joint. 1600 w. Jour N Eng Water Works Assn—Sept., 1900. No. 36536 D.

Cement-Lined Service Pipes. F. F. Forbes. Paper giving results of practical experience, with discussion. 5000 w. Jour N Eng Water Works Assn—Sept., 1900. No. 36537 D.

Pipe Joints.

Wooden Joints in Cast-Iron Water Mains. William Murdoch. Short paper, giving an account of experience at St. John, N. B. 1 plate. 1200 w. Jour N Eng Water Works Assn—Sept., 1900. No. 36535 D.

Reservoirs.

Storage Reservoirs in England (Stauweiher in England). Thomas Hofer. Notes upon English reservoirs made during a journey of inspection. 4000 w. 2 plates. Oesterr Monatschr f d Oeffent Baudienst—Sept., 1900. No. 36660 D.

The Construction of the Fells Reservoir for the Metropolitan Water Works. John L. Haward. A well illustrated paper giving an account of this part of the works for supplying Boston and vicinity with water. 4400 w. Jour N Eng Water Works Assn—Sept., 1900. No. 36534 D.

River Improvement.

The Improvement of Non-Tidal Rivers by Regulation. Abstract of report by G. T. Nelles on the improvement of a river without sufficient probable traffic to warrant its canalization. 4500 w. Eng Rec—Sept. 1, 1900. No. 36205.

Screens.

Screens and Screen Lifters; Metropolitan Water-Works, Boston and Vicinity. Chas. W. Sherman. An illustrated description of a standard design of screen, and a mechanical device for handling screens. 500 w. Eng News—Sept. 27, 1900. No. 36852.

Submerged Main.

Repairing a Submerged Water Main. Describes methods used in Cleveland, O., to patch riveted steel mains injured by anchors. 600 w. Eng Rec—Sept. 22, 1900. No. 36713.

Water Power.

Power Development of the Drainage Canal at Joliet. An illustrated description of an 8,000-horse-power water and electric power plant at a dam in the Chicago Drainage Canal. 2500 w. W Elec'n—Sept. 22, 1900. No. 36745.

Water Supply.

San Francisco's Water Supply. Engravings giving a good idea of the system, which furnishes an abundant supply, with brief explanation of the peculiar conditions. 900 w. Min & Sci Pr—Aug. 25, 1900. No. 36193.

The Bradford Water Works. James Watson. Paper before the British Association on water supply, with a description of the Bradford water works. 6000 w. Engng—Sept. 14, 1900. No. 36598 A.

Water Supply Progress at Dayton. Extracts from the annual report showing constant progress. 1500 w. Fire & Water—Sept. 1, 1900. No. 36267.

Water Waste.

The Use and Waste of Water. Extracts from a report by J. J. R. Croes, analyzing the various sources of use and waste in a large city. 2400 w. Eng Rec—Sept. 1, 1900. No. 36198.

Water Waste and Use in Washington. Extracts from a report by Capt. D. D. Gaillard, describing measurements to determine the waste and the use of water for municipal purposes. 1800 w. Eng Rec—Sept. 22, 1900. No. 36711.

Water-Works.

Lifting Water by Compressed Air. Clark Howell. Illustrates and describes novel features in the adaptation of the air-lift system to pumping water from muddy streams. 2800 w. Met Work—Sept. 15, 1900. No. 36395.

Wells.

Driven Wells (Schlagbrunnen). A discussion of the application of driven wells for local water supply. 1800 w. Gesunheits-Ingenieur—Sept. 15, 1900. No. 36663 B.

MATERIALS.

Asphalt.

The Value of Chemical Tests of Asphalt Mixtures. W. H. Broadhurst. Read before the Am. Soc. of Mun. Imp. On the mistakes in preparing asphalt mixtures which can be detected by chemical analysis. 1500 w. Eng Rec—Sept. 1, 1900. No. 36201.

Cement.

Cement Testing for Municipal Work. Horace Andrews. Read before the Am. Soc. of Munic. Imp. Suggests that cements be tested near their place of manufacture and the packages sealed and marked as to their quality. 1200 w. Munic Engng—Sept., 1900. No. 36299 C.

Slag Cement (Ueber Schlacken-Cement). Giving chemical analyses, and numerous results of tests of the Königshofer cement. 3000 w. Stahl und Eisen—Sept. 1, 1900. No. 36648 D.

The Utilization of Blast-Furnace Slag for Portland Cement Manufacture. Cecil von Schwarz. Abstract of a paper read before the Iron and Steel Institute of Great Britain, describing a method in which the slag is granulated by running it into cold water, then mixed with limestone, etc., pressed and burned. 2200 w. Eng News—Sept. 27, 1900. No. 36846.

The Whitehall Portland Cement Works. An illustrated description of the large cement mill at Cementon, Pa., with rotary kilns, and electric driving for the major portion of the plant. 2200 w. Eng Rec—Sept. 15, 1900. No. 36416.

Transverse Tests for Cement and Cement Mortar. A statement of the relative advantages of different methods of testing. 1000 w. Eng Rec—Sept. 1, 1900. No. 36195.

Concrete Mixer.

A Traveling Concrete Mixer. Illustrates and describes a novel apparatus for the preparation of concrete. 600 w. Eng News—Sept. 6, 1900. No. 36318.

Paris Exposition.

The Paris Exhibition. Notes on Materials of Construction. Accounts of a great variety of exhibits of building materials. 3000 w. Builder—Sept. 8, 1900. No. 36490 A.

Resistance.

Resistance of Materials (Resistance des Materaux). A discussion in mathematical and graphical form, of the deformations of beams under various conditions of loading. Serial. Part 1. 3000 w. Revue Technique—Sept. 10, 1900. No. 36617 D.

Sandstone.

The Relation Between Extension and Stress in Sandstone (Zur Frage der Proportionalität Zwischen Dehnungen und Spannungen bei Sandstein). C. Bach. Investigations into the strength of sandstone, with especial reference to the stresses in revolving grindstones. 2000 w. Zeitschr d Ver Deutscher Ing—Sept. 1, 1900. No. 36607 D.

Stresses.

On Wöhler's Laws. J. Gilchrist. Discusses the theory of the cause of fracture, reporting experimental investigations and giving the writer's conclusions. 5400 w. Engr, Lond—Aug. 31, 1900. No. 36359 A.

Suspended Beam.

The Determination of the Stresses in a Horizontal Beam Suspended in the Middle (Zur Bestimnung der Spanmunger, in den durch einer Geraden Balken mit Mittelgelenk Versteiften Hängeträgern). J. Melan. A mathematical treatment applicable to the case of a combined suspension and truss bridge. 1500 w. Zeitschr d Oesterr Ing u Arch Ver—Sept. 7, 1900. No. 36624 B.

Timber.

Notes on the Swedish Timber Trade. A general account of timber ports and districts, with maps. 1800 w. Builder—Sept. 8, 1900. No. 36489 A.

The Creo-Resinate Wood-Preserving Plant. Illustrated description of works at Perth Amboy, N. J., for the sterilization, vulcanizing, water-proofing and antiseptic treatment of timber. 2300 w. Eng Rec—Sept. 22, 1900. No. 36712.

The Preservation of Railway Ties in Europe. O. Chanute. Paper before the Am. Soc. C. E. giving the results of inquiries in Great Britain, France and Germany; with appendices giving specifications in those countries. 7500 w. Pro Am Soc Civ Engs—Sept., 1900. No. 36815 E.

MEASUREMENT.

Leveling.

The Theory and Practice of Precise Spirit Leveling. David A. Molitor. An elaborate paper before the Am. Soc. C. E., with illustrations, tables and curves. 32000 w. Pro Am Soc Civ Engs—Sept., 1900. No. 36814 E.

Surveying.

A New Apparatus for Measuring Geodetic Base Lines (Nouveau Dispositif d'Appareils Sewaul à la Mesure des Bases Géodésiques). A. Bergel. Advocating the use of flat iron bars floating in a bath of mercury, for making the measurement. 1000 w. Comptes Rendus—Aug. 13, 1900. No. 36638 D.

MUNICIPAL.

Convention.

The Convention of the American Society of Municipal Improvements. A report of discussions on methods of preparing municipal statistics, cement testing for small cities, and asphalt pavements. 3300 w. Eng Rec—Sept. 8, 1900. Serial. 1st part. No. 36304.

Mexico.

The Sanitation of Mexico (Assainissement de Mexico). An illustrated description of the new system of sewerage now being installed in the City of Mexico.

1800 w. Revue Technique—Sept. 10, 1900. No. 36618 D.

Pavements.

Construction and Maintenance of Brick Pavements. E. A. Kemmler. Read before the Am. Soc. of Munic. Imp. Gives an outline of experience in Columbus, O., and discusses the present standard practice. Ill. 4500 w. Munic Engng—Sept., 1900. No. 36296 C.

Construction of Granite Block Pavements. Josiah A. Briggs. Read before the Am. Soc. of Munic. Imp. Describes the standard granite-block pavement in use in city streets, giving the materials used, and details and methods of construction. 3000 w. Munic Engng—Sept., 1900. No. 36295 C.

The Construction of Asphalt Pavements. Paper by G. W. Tillson, before Am. Soc. of Munic. Imp., on the foundation, binder, wearing surface, asphaltic cement, sand, and method of laying. 2500 w. Eng Rec—Sept. 1, 1900. No. 36199.

The Construction of Standard Medina Block Stone Pavements. E. A. Fisher. Paper presented to the Milwaukee convention of the American Society of Municipal Improvements, giving a detailed description of methods of construction used in Rochester, N. Y. 3000 w. Eng Rec—Sept. 15, 1900. No. 36418.

Refuse.

Disposal of Town Refuse. Interesting details from a paper by Brierley Denham Healey, read before the Soc. of Engs., concerning cost and efficiency of various systems. 1600 w. Engr, Lond—Aug. 24, 1900. No. 36248 A.

Monograph on the Refuse of Paris (Notice Monographique sur les Ordures Ménagères de Paris). Paul Vincey. A very full account of the system of sorting and removing the garbage and wastes of Paris. Serial. Part 1. 10000 w. Bull Soc d'Encour—Aug., 1900. No. 36637 G.

The Disposal of House Refuse in Bradford. J. McTaggart. Paper before the British Association, describing the refuse destructors at Bradford, England, where the town refuse is burned, generating steam, and the residual clinker used for various purposes. 4000 w. Elec Rev, Lond—Sept. 14, 1900. No. 36737 A.

Sewage Disposal.

Sewage Disposal and Water Purification. John N. McClintock. Read before the Am. Soc. of Munic. Imp. Describes the system of purification by double filtration, or by combining the settling or septic tank with single or double filtration, commending it as certain to give pure water and prevent pollution. 4500 w. Munic Engng—Sept., 1900. No. 36298 C.

Sewage Purification. E. A. Hermann. Read before the Am. Soc. of Munic. Imp. A discussion of the various systems. 3400 w. Munic Engng—Sept., 1900. No. 36297 C.

The Leeds Sewage Disposal Experiments. From a progress report of the Sewage Committee, describing the different systems tested and giving the results obtained. 1700 w. Eng Rec—Sept. 22, 1900. No. 36708.

The Municipal Sewage Works of Berlin (Die Städtischen Kanalisationswerke Berlins). Abstracts from the official report for the fiscal year 1898-99 on the sewer system and filtration beds, giving various statistics. 1600 w. Gesundh Ing—July 15, 1900. No. 36560 B.

The Treatment of Leeds Sewage. Abstract of a report of the Leeds Sewage Committee on experiments with various systems. 1200 w. Engr, Lond—Sept. 7, 1900. No. 36465 A.

Recently Improved Methods of Sewage Disposal. J. B. Johnson. A paper before the Science Club of the Univ. of Wisconsin, criticising chemical methods and describing the bacterial reduction method. 5500 w. Bull Univ Wis—No. 40, June, 1900. No. 36539 D.

Sewers.

Deep Sewer Trenching. Illustrated description of the methods adopted in building a sewer in sand, with its invert 35 to 40 ft. below the street level. 1300 w. Eng Rec—Sept. 1, 1900. No. 36196.

Street Cleaning.

Some Actual Working Costs of Motors for Street Watering and Dust Removal. E. Shrapnell Smith. Paper before the Association of Cleansing Superintendents of Great Britain, giving the results of actual experience with steam motors in some English towns. 2000 w. Autocar—Sept. 8, 1900. No. 36528 A.

ELECTRICAL ENGINEERING

COMMUNICATION.

Cables.

Improving the Speed of Submarine Cables. An illustrated description of a method invented by T. Guilleaume for lessening the capacity and increasing the self-induction of cables by the arrangement, shape and material of the conductors. 400 w. Elec Wld & Engr—Sept. 15, 1900. No. 36403.

Increase in the Use of Gutta-Percha in Electric Cable Building. Hawthorne Hill. Discusses the demand for new cables and

the supply of gutta-percha. 1800 w. Elec Rev, N. Y.—Sept. 12, 1900. No. 36392.

Sir George S. Robertson's Presidential Address to the Geographical Section of the British Association at Bradford. Abstract of this address, treating of the British Empire and its means of inter-communication by telegraph cable, ships, etc. 3000 w. Electrician—Sept. 14, 1900. No. 36727 A.

Telegraph Cables in War and Two Cables Across the Pacific Ocean (Die Telegraphen Kabel im Kriege und Zwei Kabel durch den Stillen Ocean). A discussion of the question of neutrality of ocean cables in time of war, also a comparison of British and American routes across the Pacific. 5000 w. 1 plate. Stahl und Eisen—Sept. 15, 1900. No. 36651 D.

The Pacific Cable. A criticism of the specifications for the proposed British Pacific cable from Vancouver to Australia and New Zealand. 1100 w. Elec Rev, Lond—Sept. 14, 1900. No. 36736 A.

Cable Steamer.

See Marine Engineering.

Dynamo Currents.

The Use of the Dynamo and Storage Battery in Telegraph Offices. W. J. Camp. Paper before the Canadian Electrical Association, describing different systems in use, with diagrams. 2000 w. Canadian Elec News—Sept., 1900. No. 36508.

Philippines.

Telegraphy in the Philippines. G. D. Rice. An illustrated description of crude methods of Filipino mechanics, and rough-and-ready devices which are used. 1800 w. W Elect'n—Sept. 22, 1900. No. 36747.

Telephone Work and Prospects in the Philippines. The first part tells of the natives' opposition, the system adopted, etc. 1600 w. W Elect'n—Sept. 8, 1900. No. 36347.

Space Telegraphy.

The Slaby-Arco System of Wireless Telegraphy. Illustrates and describes this system, and states the advantages that caused it to be adopted by the German Navy. 800 w. Elec Rev, Lond—Aug. 31, 1900. No. 36368 A.

Synchronograph.

A Practical Telegraph Transmitter Using the Sine-Wave for Operating the Wheatstone Receiver. A. C. Crehore and G. O. Squier. Abstract of a paper before the International Electrical Congress, Paris, giving a description of the synchronograph and accounts of latest practice with it. 600 w. Elect'n, Lond—Sept. 7, 1900. No. 36495 A.

Telegraphone.

Poulsen Telegraphone. An illustrated description of this apparatus for making a magnetic record of telephone messages on steel wire or ribbon. 1000 w. Sci Am—Sept. 22, 1900. No. 36580.

Telephones.

The Development of Telephony in the German Empire (Entwickelung der Allegenieinen Fernsprechanlagen im Reich-Telegraphengebiet). A very complete tabulated account of the entire German telephone system, including Bavaria and Würtemberg. 12000 w. Elektrotech Zeitschr—Aug. 9, 1900. No. 36676 B.

The New Equipment of the Munich Telephone Central (Die Neuen Münchener Telephon - Centraleinrichtungen). Abstract from the official report of the Bavarian Post and Telegraph Department, describing the new exchange switchboards with incandescent lamp signals. Serial. Part 1. 5000 w. Elektrotech Zeitschr—Aug. 23, 1900. No. 36682 B.

Telephone Battery.

Central Battery Telephone System. A description, with diagrams, of a system invented by W. W. Dean, whereby separate batteries at sub-stations may be dispensed with. 1200 w. Elec Wld & Engr—Sept. 15, 1900. No. 36401.

Telephone Circuit.

Telephone Trunk Circuit. A description, with diagram, of an invention by D. S. Hulfish, which provides means to automatically give and remove the busy-test condition to and from the operator's telephone at the switching plug terminal. 1000 w. Elec Wld & Engr—Sept. 15. 1900. No. 36402.

Telephone Signal.

Telephone Jack and Rolling Indicator. An illustrated description of a telephone switchboard signal in which the indicating member is a ball, ring or disk. 800 w. Elec Wld & Engr—Sept. 22, 1900. No. 36719.

Wireless Telephony.

Wireless Telephony. Sir Wm. H. Preece. Paper before the British Association, giving an illustrated description of the author's successful experiments in telephoning across several miles of water, without wires. 1200 w. Elec Engr, Lond—Sept. 14, 1900. No. 36742 A.

DISTRIBUTION.

Aluminum Conductors.

The Use of Aluminum Wire for Electric Transmission Lines. F. A. C. Perrine and F. G. Baum. Abstracted from a paper before the American Institute of Electrical Engineers, giving the practical results attained on a 43-mile three-phase line in California. 2500 w. Eng News—Sept. 27, 1900. No. 36849.

Condensers.

The Employment of Condensers. P.

Boucherot. Paper read at the Paris International Electrical Congress on the application of condensers in commercial alternating current work. 2000 w. W Elect'n—Sept. 22, 1900. No. 36748.

Great Britain.

Electric Power Distribution in Great Britain. W. H. Booth. A review of the consequences of the recent decisions of the Parliamentary Commission, showing the difficulties due to municipal intermeddling. 4000 w. Engineering Magazine—Oct., 1900. No. 36691 B.

Insulator.

High Voltage Heated Insulator. An illustrated description of A. S. Larsen's method of heating insulators by induced currents, in order to prevent moisture forming. 500 w. Elec Wld & Engr—Sept. 22, 1900. No. 36720.

Munich.

An Industrial Object Lesson. An editorial describing a water-power electric plant near Munich, and discussing the industrial and economic effects of this plant and of electric power in general. 1100 w. Elect'n, Lond—Sept. 7, 1900. No. 36494 A.

ELECTRO-CHEMISTRY.

Electrolysis.

The Hans A. Frasch Electrolytic Process for Excavating Metals, as Applied to Copper-Nickel Matte. Brief description of the important points in this process, and conclusions from personal investigation. Promises to greatly reduce the cost of producing the useful metals. 2000 w. Eng & Min Jour—Sept. 8, 1900. No. 36321.

Electrolyte.

A Galvanic Element with an Electrolyte of Constant Conductivity, Which Can Be Used Both as a Primary and as a Secondary Cell (Ein Primär wei Sekundär Benutzbares Galvanisches Element mit Elektrolyten von Unveränderlichen Leitungsvermögen). Ernst W. Jungner. It is proposed to use a solution of an alkali hydrate, and it is claimed that neither its concentration nor its composition will alter. 1200 w. Elektrochem Zeitschr—Aug., 1900. No. 36561 G.

Electrolytic Cell.

Feeding Arrangement for Electrolytic Apparatus (Speisevorrichtung für Elektrolytische Zersetzungs-apparate). Raul Girouard. Illustrated description of an apparatus in which liquid is transferred from a reservoir to an electrolytic cell automatically, without the two bodies of liquid coming in contact with each other. 900 w. Elektrochem Zeitschr—Aug., 1900. No. 36562 G.

Ionization.

The Transfer of Hydrogen Ions as Determined by Measurements with Lead Accumulators (Die Ueberführungszahl von Schwefelsäuregemischen aus Messungen am Blei-Akkumulator). Arthur Kendrick. Account of research work, in which the electromotive-force of the lead accumulator was exactly determined, and also the migration of hydrogen ions. 3000 w. Zeitschr f Elektrochem—Aug. 2, 1900. No. 36564 D.

Paris Exposition.

Electro-Chemistry and its Allied Interests at the Paris Exposition of 1900 (Die Elektrochemie und ihre Weitere Interessensphäre auf der Pariser Weltausstellung 1900). Prof. W. Borchers. A general review of electrochemical, mineralogical and other exhibits. Serial. 1st part. Zeitschr f Elektrochem—July 26, 1900. No. 36563 D.

Polarization.

On the Production of Asymmetrical Alternating Currents by Means of Electrolytic Polarization. W. L. Hildburgh. Doctorate thesis on electrolytic method of rectifying alternating currents, with curves and tables. 1 plate. 6500 w. School of Mines Quar—July, 1900. No. 36540 D.

Print Works.

Electro-Chemistry in a Dye and Print Works. A. E. Sunderland. Read at Bradford, Eng., Technical College. Reviews the applications of electricity in works of this character, the action of the electric current on dye-wares, giving some of the results, etc. 2000 w. Elect'n, Lond—Aug. 31, 1900. No. 36367 A.

Zinc.

The Electrolytic Production of Zinc with the Employment of Insoluble Anodes, Combined with the Profitable Use of the Material of the Anodes (Elektrolytische Zinkgewinnung unter Anwendung Unlöslicher, Anoden, Verbunden mit Gleichzeitiger Verwertung des Anodenmaterials). J. Routschewsky. An illustrated description of a process in which the electrolyte is an acid zinc sulphate solution and the anode is of lead. Serial. 2 parts. 4500 w. Zeitschr f Elektrochemie—July 12, 19, 1900. No. 36556 each D.

ELECTRO-PHYSICS.

Dust Figures.

Dust Figures of Electrostatic Lines of Force. David Robertson. An illustrated account of apparatus used and figures obtained. 1600 w. Elec Rev, Lond—Sept. 7, 1900. No. 36499 A.

Electric Force.

Some Remarks Upon the Cause and Nature of the Electric Force. R. C. Shettle. Facts and arguments in support of the hypothesis that matter was formed by cohesion, and that the part which did not undergo condensation constitutes the

ether, and is the basis of the electric force. 3500 w. Elec Engr, Lond—Aug. 24, 1900. No. 36229 A.

Electric Quantities.

On the Nature of the Electric and Magnetic Quantities. Reginald A. Fessenden. Letter, in reply to a criticism, on the writer's system of "Qualitative Mathematics," and explanation of natural phenomena. 1000 w. Elec Rev, Lond—Sept. 14, 1900. No. 36738 A.

Electrical Stimulus.

On the Similarity of Effect of Electrical Stimulus on Inorganic and Living Substances. Prof. J. Chunder Bose. A paper before the British Association, on molecular change produced by electric stimulus. Also editorial. Serial. 1st part. 5000 w. Electrician—Sept. 14, 1900. No. 36724 A.

Electromagnetism.

Electromagnetic Mechanisms. Silvanus P. Thompson. A paper before the International Electrical Congress, at Paris, giving electromagnetic principles and their applications, with the principal classes of electromagnetic mechanisms. 1800 w. Elec Rev, N. Y.—Sept. 19, 1900. No. 36731.

Electromagnets.

The Design of Tractive Electromagnets. Lamar Lyndon. A mathematical letter, with diagram, showing how the travel of a plunger may be lengthened by shaping the pole faces conically. 800 w. Elec Wld & Engr—Sept. 15, 1900. No. 36404.

Hydro-Electricity.

The Production and Utilization of Electricity from Steam (De la Production et dé l'Utilisation de l'Electricité Tirée de la Vapeur d'Eau). E. E. Stahl. Showing the conditions under which a current may be developed from a steam jet. Possible applications are given. Serial. Part I. Revue Technique—Aug. 10, 1900. No. 36613 D.

Interrupter.

Liquid Interrupters Connected in Parallel (Die Neuen Flüssigkeitsunterbrecher in Parallelschaltung). E. Ruhmer. Giving the results of experiments with Wehnelt interrupters. 2000 w. Elektrotech Zeitschr—Aug. 16, 1900. No. 36678 B.

Lines of Force.

The Distribution of Lines of Force in a Dynamo (Die Gesetze der Kraftlinienvertheilung über den Umfang der Dynamomaschinen). Ch. Westphal. An analytical investigation of the laws governing the distribution of magnetic force, with diagrams for practical use. 3500 w. Elektrotech Zeitschr—Sept. 6, 1900. No. 36685 B.

Wave Forms.

Conditions Affecting the Wave Form of Alternators. L. A. Herdt and E. M. Archibald. Paper before the Canadian Electrical Association, discussing forms of electromotive-force waves under commercial conditions, with diagrams. 800 w. W Elect'n—Sept. 15, 1900. No. 36505.

GENERATING STATIONS.

Alternating-Currents.

Periodicity in Alternating Current Apparatus. James M. Andrews. Read before the Ohio Elec. Lgt. Assn. Discusses separately each periodicity, its value as regards transformers, line losses, induction motors, etc., and the different systems. 3500 w. W Elect'n—Sept. 8, 1900. No. 36348.

Apparatus.

Hints on the Care of Generators and Motors. John H. Hertner. An illustrated article giving practical points. 1500 w. Engr, U. S. A.—Sept. 15, 1900. No. 36488.

Combined Plant.

Electric, Gas and Heating Plants. Alton D. Adams. An article calling attention to the possibilities of saving by combination of electrical supply stations and gas works. 2000 w. Elec Rev, N. Y.—Sept. 19, 1900. No. 36728.

The Operation of a Combined Lighting and Power Plant. J. H. Perkins. Read before the Ohio Elec. Lgt. Assn. An account of practice at Youngstown, O. 3300 w. W Elect'n—Sept. 1, 1900. No. 36350.

Consolidation.

Commercial Analysis of Small and Unprofitable Electric Lighting and Power Enterprises. William D. Marks. Analytical study of the factors in enterprises dealing with small amounts. 3000 w. Elec Wld & Engr—Sept. 1, 1900. No. 36217.

Costs.

Lightning's Table of Costs. An analysis of the accounts of electricity supply undertakings established under provisional orders in the United Kingdom. Tables of statistics of public and private corporations. 4000 w. Lightning—Sept. 6, 1900. No. 36504 A.

Design.

Foreign and English Electrical Engineering. Part first considers slow-speed steam dynamos. These articles will discuss the general growth and position of the electrical industry, the differences of practice and conditions, and related subjects. 3400 w. Engr, Lond—Aug. 24, 1900. Serial. 1st part. No. 36244 A.

Dynamos.

The Construction of Large Dynamos as Exemplified at the Paris Exhibition. Silvanus P. Thompson. Abstract of paper

before the British Association, giving a review of the dynamos at the Exhibition and calling attention to the tendencies in design which they illustrate. 1600 w. Elec Engr, Lond—Sept. 14, 1900. No. 36740 A.

Dynamotors.

Dynamotors versus Motor Generators. Alton D. Adams. A comparison showing the former to be superior in many ways, but that the other machine was brought into favor because of the difficulty in regulating the secondary pressure in the dynamotor. 1800 w. Elec Wld & Engr—Sept. 8, 1900. No. 36327.

Earnings.

How Can Central Stations Earn Larger Revenues? Albert B. Herrick. A discussion of the possible resources for increasing the revenue. 2000 w. Elec Wld & Engr—Sept. 1, 1900. Serial. 1st part. No. 36214.

Economy.

The Future of Electrical Power. Summary of a popular lecture by Prof. S. P. Thompson, advocating the substitution of large steam engines for small ones, and the establishment of large central stations using coal fuel. 700 w. Ir & Coal Trds Rev—Sept. 14, 1900. No. 36776 A.

Exposition.

Electricity at the Paris Exposition (Die Elekricität auf der Pariser Weltausstellung). Désiré Korda. The first instalment of an extended report. This article discusses the polyphase generators exhibited. Serial, Part I. 2000 w. Elektrotech Zeitschr—Aug. 23, 1900. No. 36679 B.

Some Swiss Exhibits at Paris. Frank C. Perkins. A short illustrated account of some polyphase generators. 500 w. W Elect'n—Sept. 15, 1900. No. 36506.

Generating Set.

Electrical Generating Set of 1,000 Horse Power (Groupe Electrogène de 1,000 Chevaux). Ch. Parcey. A description of the horizontal Corliss engine of Escher, Wyss & Co., of 1,000 h.p., and the Oerlikon electrical generator of 1,300 kilowatts at the Paris Expositon. 1000 w. Génie Civil—Sept. 1, 1900. No. 36634 D.

Generators.

Single and Polyphase Alternate Current Generators. Discusses the principles upon which these machines are constructed, and gives an illustrated description explaining their operation. Col Guard—Aug. 24, 1900. Serial. 1st part. No. 36234 A.

Glasgow.

The Electricity Supply of Glasgow. An illustrated general description of the new Port Dundas electricity works for lighting Glasgow. 3000 w. Engr. Lond—Sept. 14, 1900. No. 36702 A.

The New Electricity Works of the Glasgow Corporation. An historical review of the enterprise and an illustrated description of the new works. Serial. 1st part. 2200 w. Electrician—Sept. 14, 1900. No. 36722 A.

High Pressure.

Modern High-Pressure Apparatus (Ueber Moderne Hochspannungsapparate). H. A. Bertram. Describing improved arrangements of switches, switchboards, transformers, insulators, etc., for high-pressure currents. Two articles. 7000 w. Elektrotech Zeitschr—Aug. 9, 16, 1900. No. 36674 each B.

Hospital Plant.

The New Power Plant of the Massachusetts General Hospital. Illustrated description of a plant designed to furnish electric current, steam heat and hot water to a group of buildings. 1800 w. Eng Rec—Sept. 1, 1900. No. 36204.

Isolated Plants.

The Steam-Driven Isolated Plant—Does It Pay? W. D. Ennis. Comparisons of the cost with isolated plants and the cost of buying current from central stations. 3000 w. Elec Wld & Engr—Sept. 22, 1900. No. 36715.

Lachine.

The Electric Light and Power Plant of the Lachine Rapids Hydraulic & Land Company. Charles T. Child. Illustrated description of a twelve-thousand horsepower hydraulic and electric station that lights Montreal and furnishes power to its industries. 3500 w. Elec Rev, N. Y.—Sept. 12, 1900. No. 36391.

Load Factors.

Load Factors on Traction Stations. William H. Booth. States the conditions of working in the power house of an electric tramway, and the means of determining the load factor. 2000 w. Elec Rev, Lond—Aug. 31, 1900. No. 36370 A.

Motor-Generator.

Some Experiments with a Motor-Generator. An account of tests made to ascertain why the machine failed to do the work for which it was designed. Ill. 1600 w. Am Elect'n—Sept., 1900. No. 36269.

Rathmines.

Rathmines Municipal Electricity Works. An illustrated description of a small but very complete plant near Dublin. 2000 w. Engr, Lond—Sept. 7, 1900. No. 36468 A.

Rotary Converters.

Some Experiments with Rotary Converters. A. G. Grier and J. C. Hyde.

Paper before the Canadian Electrical Association, with diagrams and curves. 1500 w. Canadian Elec News—Sept., 1900. No. 36511.

South London.

The City and South London Railway. A well illustrated account of the new generating station of this underground road. 2400 w. Elec Rev, Lond—Sept. 7, 1900. No. 36500 A.

Station Design.

Some General Conditions Governing Power Station Design. Philip Dawson. From a paper before the Light Railway and Tramway Conference, London, with tables. 2000 w. St Ry Rev—Sept. 15, 1900. No. 36517 C.

Variable Load.

See Mechanical Engineering. Steam Engineering.

LIGHTING.

Address.

The Association of Edison Illuminating Companies; Its Field and Work—Past, Present and Future. John W. Lieb, Jr. Presidential address before the Saratoga Springs Convention, Sept., 1900. 2000 w. Elec Rev, N. Y.—Sept. 12, 1900. No. 36393.

Arc.

Progress in Arc Lighting by Alternating-Current Lamps. H. W. Hillman. Read before the Ohio Elec. Lgt. Assn. Discusses the subject in its relation to street lighting principally. 2500 w. W Elect'n—Sept. 1, 1900. No. 36349.

The Production of an Artificial Light of the Same Character as Daylight. A. Dufton and W. M. Gardner. Abstract of paper before British Association, discussing the subject generally, and describing a means of modifying the electric arc's light by passing it through pale blue glass. 800 w. Electrician—Sept. 14, 1900. No. 36725 A.

Auditorium Lighting.

The Lighting of the Coliseum. Illustrates and describes the arrangements for lighting an auditorium said to have a capacity of 10,000. 1700 w. W Elect'n—Sept. 8, 1900. No. 36346.

Convention.

The Field and Work of the Association of Edison Illuminating Companies. J. W. Lieb, Jr. Presidential address at the Saratoga convention of the Association. 2100 w. W Elect'n—Sept. 22, 1900. No. 36749.

The Twenty-first Edison Convention. An outline of the proceedings of this convention, with a general review of some of the work of past conventions. 4000 w. Elec Wld & Engr—Sept. 15, 1900. No. 36400.

Decorative Illumination.

Special Lighting Effects at the Paris Exposition. Brief illustrated description of some of the striking night effects. 1000 w. Elec Wld & Engr—Sept. 8, 1900. No. 36326.

The Decorative Illumination of Electricity Building, Paris Exposition. Illustrated detailed description. 2500 w. Elec Wld & Engr—Sept. 1, 1900. No. 36215.

Fountains.

The Electric Fountains at the Paris Exposition. A well illustrated description of the Chateau d'Eau and the electric fountains. 2500 w. Elec Wld & Engr—Sept. 22, 1900. No. 36714.

Incandescent.

A New Incandescent Street Lamp Fixture. A. B. Proal. Reviews the systems used in incandescent street lighting, and gives illustrated description of a new shunting device. 1200 w. Elec Wld & Engr—Sept. 1, 1900. No. 36218.

High Voltage Incandescent Lamps. George D. Shepardson. A discussion of the present situation and the conclusion that these lamps are a commercial success and coming into extensive use. 3600 w. Elec Wld & Engr—Sept. 1, 1900. No. 36216.

Nernst Lamp.

The Nernst Lamp in Commercial Form at the Paris Exposition. C. L. Durand. An illustrated description of present forms of the Nernst lamp. 2500 w. Elec Rev, N. Y.—Sept. 19, 1900. No. 36729.

Oxides.

The Conductivity of Oxides at High Temperatures (Ueber die Leitungsfahigkeit der Oxyde bei Hohen Temperaturen). J. Sohlman. An examination of a large number of oxides with a view of determining their conductivity and use for incandescent lighting. 1800 w. Elektrotech Zeitschr—Aug. 19, 1900. No. 36675 B.

MEASUREMENT.

Alternating Current.

Measurement of Alternating Currents by Current and Pressure Meters (Methode zur Bestimmung des Effektes in Wechselstromkreise mittels Strom-und Spannungsmesser). E. Reisz. An improvement on the ordinary method, requiring only two measuring instruments. 1200 w. Elektrotech Zeitschr—Aug. 23, 1900. No. 36681 B.

Meter.

A Combination Integrating Wattmeter and Maximum-Demand Indicator. J. H. Barker. Paper read before the British Association, discussing maximum demand and describing a combined meter

and indicator. 1800 w. Elec Eng, Lond—Sept. 7, 1900. No. 36502 A.

Switchboard Instruments—Integrating Wattmeters and Ammeters. Wm. Baxter, Jr. An illustrated description of some electrical measuring instruments. 2700 w. Am Mach—Sept. 27, 1900. No. 36818.

The Holden Electric Meter (Compteur d'Energie Electrique, Système Holden). J. A. Montpellier. A motor meter operating on the principle of discontinuous integration. The details of construction and operation are fully described. 2000 w. Electricien—Aug. 11, 1900. No. 36686 B.

Moment of Inertia.

On Some Methods of Determining Experimentally the Moments of Inertia of the Rotors of Dynamos and Alternators. Alfred Hay. Part first states two problems in which the moment of inertia is of importance, and commences the discussion of methods by means of which this quantity may be experimentally determined. 1400 w. Elec Rev, Lond—Aug. 24, 1900. Serial. 1st part. No. 36231 A.

Polyphase Systems.

A Graphical Method of Determining the Current and Pressure in Connected Polyphase Systems (Eine Graphische Methode zur Bestimmung der Strom- und Spannungswerthe in Verketteten Mehrphasensystemen). F. Blanc. Giving the derivation of graphical diagrams, with examples of their practical application. Two articles, 5000 w. Elektrotech Zeitschr—Aug. 30, Sept. 6, 1900. No. 36684 each B.

Rating.

The Necessity for a Normal Rating of Capacity, Temperature and Efficiency of Electrical Machines (Ueber die Nothwendigkeit der Aufstellung von Normen für die Bestimmung und Augabe von Leistung, Erwärmung und Wirkungsgrad Elektrischer Maschinen). G. Dettmar. A paper before the German Electrical Engineers urging the adoption of standards. 10000 w. Elektrotech Zeitschr—Aug. 30, 1900. No. 36683 B.

Testing.

A Running Test on Street Car Motors. E. C. Parham. Discusses the causes that help to make the drops across the two motors to differ. 1400 w. Am Elect'n—Sept., 1900. No. 36271.

The Electric Testing Train on the Wannsee Road, near Berlin (Der Elektrische Versuchsbetrieb auf der Wannseebahn bei, Berlin). R. Rinkel. A full account of comparative trials between steam and electric driving, with description of the apparatus and results. 5000 w. Zeitschr d Ver Deutscher Ing—Sept. 8, 1900. No. 36611 D.

POWER APPLICATIONS.

Canal Haulage.

Electric Traction for Canals. Report by Consul-General Richard Guenther, Frankfort, on experiments made on behalf of the Prussian Government by Siemens & Halske on a short length of the Finow Canal, between Berlin and Stettin. 600 w. U. S. Consular Reports—Sept. 20, 1900. No. 36544.

Cranes.

Electrical Travelling Cranes. C. W. Hill. A general review, with a short illustrated description of a multiple-motor crane. 1200 w. Elec Rev, Lond—Sept. 7, 1900. No. 36497 A.

Electric Traveling Crane with Moveable Frame (Grue Électrique à Charpente Mobile). An illustrated account of the travelling wharf crane on the Quai d'Orsay at the Paris Exposition. 1500 w. Revue Technique—Aug. 25, 1900. No. 36614 D.

Diagrams.

Diagrams for Induction Motors (Diagramme für Induktionsmotoren). R. Goldschmidt. Deriving diagrams for showing the performances for various kinds of induction motors. 4500 w. Elektrotech Zeitschr—Aug. 16, 1900. No. 36677 B.

Domestic.

Unutilized Comforts of Electricity. R. S. Hale. A general description of various devices, which can be easily applied and do not add much to cost of wiring a house. 1000 w. Elec Wld & Engr—Sept. 22, 1900. No. 36716.

Electric Driving.

Electrical Power Transmission in Smelting Works. A well illustrated description of a plant for generating electricity for power purposes in a large smelting works. 3200 w. Elec Rev, Lond—Sept. 14, 1900. No. 36739 A.

On the Subdivision of the Motor Equipment in Electrically-Driven Workshops. Short discussion of the subject, with some examples of European practice. 1200 w. Elect'y, Lond—Sept. 7, 1900. No. 36501.

The Commercial Value of Independent Electric Driving (Elektrischer Einzelantrieb und seine Wirthschaftlichkeit). O. Lasche. Showing the great advantages in handling materials and conducting work by use of electric driving. 2000 w. Stahl und Eisen. Sept. 15, 1900. No. 36652 D.

The Electric Driving of Ironworks and Rolling Mills. O. Lasche. Abstract from *Technisches Centralblatt*. An illustrated account of the driving at the rolling mills of the Oberspree cable works, and a discussion of the advantages as

compared with steam driving. 2200 w. Elect'n, Lond—Aug. 31, 1900. No. 36366 A.

The Value of Independent Electric Driving (Elektrischer Einzelantrieb und seine Wirtschaftlichkeit). O. Lasche. Showing especially the great advantages in the clearing of belts, etc., from workshops by the use of electric driving. Serial, Part I. 4000 w. Zeitschr d Ver Deutscher Ing—Sept. 8, 1900. No. 36610 D.

Wellington Foundry, Lincoln. A general description of the large machine and engine works of William Foster & Co., which are equipped for the electric driving of the machinery. 2400 w. Engr, Lond—Sept. 7, 1900. No. 36467 A.

Induction Motors.

Alternating-Current Induction Motors. A. C. Eborall. The full report of the discussion on the above paper, reprinted from the journal of the Institution of Electrical Engineers. 7000 w. Elect'n, Lond—Sept. 7, 1900. No. 36496 A.

Lift.

An Electric Stair Lift. A well illustrated description of the Dodge link-belt stair lift, in which the treads are horizontal. 700 w. Elec Wld & Engr—Sept. 22, 1900. No. 36721.

Electric Inclined Elevators for the Elevated Railway. A short illustrated description of the Reno inclined elevator at the Manhattan Elevated Railroad Station at Third avenue and Fifty-ninth street. 400 w. Elec Wld & Engr—Sept. 15, 1900. No. 36399.

Motor.

Design for a Three Horse-Power Motor. Cecil P. Poole. Illustrates and describes a design prepared with a view to simplifying the work without sacrificing the efficiency, or making the machine unduly heavy. 1500 w. Am Elect'n—Sept., 1900. No. 36270.

See Mechanical Engineering, Automobilism.

Polyphase.

Theory of Asynchronous Polyphase Motors (Theorie der Asynchronen Mehrphasen motoren). G. Ossanna. A graphical derivation of the theory of the polyphase motor. 2500 w. Elektrotech Zeitschr—Aug. 23, 1900. No. 36680 B.

Power Factor.

Power Factor as Affecting Operation and Investment, with Special Reference to Induction Motors and Enclosed Arc Lamps. F. H. Leonard, Jr. Paper before the Canadian Electrical Association, giving a general discussion of the subject. 2800 w. Canadian Elec News—Sept., 1900. No. 36510.

Starting Switch.

An Automatic Switch for Starting Electric Motors. An illustrated description of an automatic switch invented by Walter F. Jones, to prevent an undue rush of current at starting motors. 2000 w. Col Guard—Sept. 14, 1900. No. 36763 A.

TRANSMISSION.

Regulation.

Regulation in Long-Distance Power Transmission by Electricity. Frederic A. C. Perrine. Abstracted from a paper read before the Pacific Coast Elec. Trans. Assn. Calls attention to points demanding careful consideration. 2200 w. Eng News—Sept. 6, 1900. No. 36317.

Tesla Patents.

The Tesla Patents. Decision of Judge Townsend of the United States Circuit Court of Connecticut in favor of the Tesla patents for the polyphase transmission of power in the suit of the Westinghouse Elec. & Mfg. Co., against the New England Granite Co. 6000 w. Elec Rev, N. Y.—Sept. 19, 1900. No. 36733.

MISCELLANY.

Austro-Hungary.

The Condition of Heavy Electrical Engineering in Austro-Hungary (Die Lage der Starkstromindustrie in Oesterreich-Ungarn). A general review of the electrical engineering situation, taken from the Vienna *Electro-Techniker*. 1900 w. Zeitschr f Klein-u Strassenbahnen—Aug. 1, 1900. No. 36553 C.

Congress.

International Electrical Congress. An account of the proceedings of the International Electrical Congress at Paris, with abstracts of the principal papers presented. 6000 w. Elec Wld & Engr—Sept. 15, 1900. No. 36398.

The International Electrical Congress. Short abstracts of various papers presented. 2100 w. Elec Wld & Engr—Sept. 22, 1900. No. 36717.

Exposition.

Electricity at the Pan-American Exposition. A description and floor plan of the Electricity Building. 1500 w. W Elect'n—Sept. 22, 1900. No. 36746.

The Palace of Electricity at the Exposition of 1900 (Exposition de 1900. Palais de l'Electricité). R. Weil. Giving details of the framework of the construction of this important building of the exposition, and interior and exterior views, including the Chateau d'Eau, or illuminated electric fountain. 3000 w. 1 plate. Génie Civil—Sept. 1, 1900. No. 36633 D.

GAS ENGINEERING

Acetylene.

Acetylene for Railroad Lighting. An illustrated description of the Bournonville Generator. 500 w. R R Gaz—Sept. 28, 1900. No. 36807.

Acetylene for Train Lighting. A. Lipschultz. From a paper before the Civil Engineers' Society of St. Paul, Minn., on "The Use of Acetylene in Railway Station and Train Lighting." 3000 w. Am Gas Lgt Jour—Sept. 17, 1900. No. 36473.

Alkali Works.

The Alkali Works Report. Harold G. Colman. On the parts of the report of interest to gas manufacturers, and also an extract on the desulphurizing of gas liquor. 4000 w. Gas Wld—Sept. 1, 1900. No. 36365 A.

Ammoniacal Liquor.

The Report of the Chief Inspector Under the Alkali Act. The Constitution and Analysis of Ammoniacal Liquor. From the report of R. Forbes Carpenter, giving the results of examinations of the constitution of various ammoniacal liquors from English and Scotch sources. 4000 w. Jour Gas Lgt—Sept. 11, 1900. No. 36798 A.

Calorific Power.

The Heating and Lighting Power of Coal Gas. T. Fairley. Paper read before the British Association, showing the relation between the heating and lighting powers of coal gas. 900 w. Jour Gas Lgt—Sept. 18, 1900. No. 36828 A.

Congress.

The International Gas Congress. An account of the proceedings of the Gas Congress at Paris, with abstracts of the papers read. 13000 w. Gas Wld—Sept. 8, 1900. No. 36474 A.

The International Gas Congress in Paris. A review of the proceedings and a résumé of the papers read. 20000 w. Jour Gas Lgt—Sept. 11, 1900. No. 36795 A.

The International Gas Congress. Opening address of the president, M. Theodore Vautier. A general review of gas engineering. 7000 w. Jour Gas Lgt—Sept. 18, 1900. No. 36821 A.

Cyanides.

The Production and Manufacture of Cyanides in Gas-Works. Dr. Bueb. A paper before the International Gas Congress, Paris, giving a process of extracting cyanogen from illuminating gas by contact with a solution of an iron salt. 2000 w. Jour Gas Lgt—Sept. 18, 1900. No. 36823 A.

Dellwik Process.

The Dellwik Process. Wm. Young. From a paper before the North British Association of Gas Managers, giving an account of a process in which intense local heating is produced by an air blast. 1000 w. Pro Age—Sept. 15, 1900. No. 36472.

Distribution Losses.

How to Diminish Distribution Losses. P. H. Gibbons. A paper before the "Congrès International de l'Industrie du Gaz en 1900," at Paris, containing a general discussion of causes of losses and means of prevention. 3000 w. Pro Age—Sept. 15, 1900. No. 36471.

Education.

Educational Work of a Gas Association. Alfred E. Forstall. A paper before the "Congrès International de l'Industrie du Gaz en 1900," at Paris, giving an account of the work of the American Gas Light Association in educating men and boys employed in gas-works. 2700 w. Pro Age—Sept. 15, 1900. No. 36470.

Foul Gases.

Treatment of Foul Gases from Sulphate Plants. An account of interesting experiments extracted from the annual report of the Chief Inspector under the Alkali Acts, in England. 3400 w. Gas Wld—Aug. 25, 1900. No. 36298 A.

High Pressure.

The Reduction of the Cost of Distribution by the Use of High Pressures. Fred. H. Shelton. Paper before the Paris Gas Congress, advocating the use of high pressure and showing its advantages; with illustrations. 5000 w. Gas Wld—Sept. 15, 1900. No. 36793 A.

Hydrocyanic Acid.

The Absorption of Hydrocyanic Acid from Illuminating Gas. Dr. A. Smits. Paper communicated to the International Gas Congress, Paris, on the production of yellow prussiate (ferrocyanide) of potash by the wet process. 900 w. Jour Gas Lgt—Sept. 18, 1900. No. 36824 A.

Inclined Retorts.

Inclined Retorts. C. E. Brackenbury. A paper before the International Gas Congress at Paris, giving an illustrated account of up-to-date English practice with inclined retorts for carbonizing coal. 2800 w. Gas Wld—Sept. 8, 1900. No. 36476 A.

Mains.

Laying a 24-inch Gas Main Across the Harlem River. G. H. P. McVey. An illustrated description of work undertaken by the Consolidated Gas Co., to connect

Manhattan and the Bronx, New York. 1200 w. Sci Am—Sept. 15, 1900. No. 36386.

Submerged Gas Mains. An illustrated account of work done to connect the district beyond the Harlem River, known as the Bronx, with the mains of the Consolidated Gas Co., of New York. 1000 w. Pro Age—Sept. 1, 1900. No. 36209.

Meters.

Slot Consumption Where Meters and Fittings, etc., are Supplied. George Helps. An opinion on paying averages, and one way of obtaining them. 2500 w. Jour Gas Lgt—Aug. 28, 1900. No. 36251 A.

Naphthalene.

A Method of Preventing Naphthalene Obstructions. Dr. Bueb. A paper before the International Gas Congress, Paris, giving a process of abstracting naphthalene from gas by bringing the latter, as it leaves the tar extractor, into intimate contact with a tar oil of very high boiling point. 1000 w. Jour Gas Lgt—Sept. 18, 1900. No. 36822 A.

Natural Gas.

Natural Gas. Its Production and Consumption. Abstract of a U. S. Geological Survey report compiled by F. H. Oliphant, comprising a survey of the gas fields, a discussion of the question of their exhaustion, and statistics concerning the utilization of natural gas in iron and steel industries. 2000 w. Ir Age—Sept. 27, 1900. No. 36756.

Paris.

The Visit to the Clichy Works of the Paris Gas Company. A description, with plan of these large and complete works, which were visited by the delegates to the International Gas Congress. 1000 w. Jour Gas Lgt—Sept. 11, 1900. No. 36796 A.

Paris Exhibition.

The Gas Industry of the Exposition of 1900. J. Leroy, in *La Nature*. Illustrated account of the work done by the Compagnie Parisienne du Gas and the applications within the Exposition enclosure. 2000 w. Sci Am Sup—Sept. 15, 1900. No. 36388.

Power Gas.

The Blast Furnace as a Power Producer. A short illustrated account of the Thwaite-Gardner system of using blast-furnace gases in gas engines. 1000 w. Ir & Steel Trds Jour—Sept. 15, 1900. No. 36781 A.

Pyrometer.

The Measurement of High Temperatures. Alten S. Miller. Paper before the Paris Gas Congress, describing the Uehling-Steinbart pneumatic pyrometer, and advocating its use in gas works. 1100 w. Gas Wld—Sept. 15, 1900. No. 36794 A.

Retort House.

Waverley Association of Gas Managers. Half-yearly meeting at Dalkeith. The address of the president, W. McGiffen, on the practical working of the retort house, and the ensuing discussion. 4000 w. Jour Gas Lgt—Sept. 18, 1900. No. 36827 A.

Stoves.

Gas Stoves (Die Gasheizöfen). E. Nicolaus. Reviewing the development of the gas stove for warming rooms, and discussing the conditions necessary for healthfulness. Serial, Part I. 3000 w. Gesundheits-Ingenieur—Aug. 31, 1900. No. 36662 B.

Water Gas.

Carburetted Water Gas and Its Use in Coal-Gas Works. Henri Sospicio. An illustrated paper before the International Gas Congress, Paris, giving methods of water-gas manufacture; with discussion by A. G. Glasgow. 6000 w. Jour Gas Lgt—Sept. 18, 1900. No. 36825 A.

Water Gas as a Remedy for the Prevalent Scarcity of Coal. H. Dicke. Presenting the advantages due to the Dellwik-Fleischer process. 2000 w. Jour Gas Lgt—Aug. 28, 1900. No. 36250 A.

Welsbach.

Incandescent Gas Lighting. Dr. H. Bunte. A paper before the International Gas Congress, at Paris, showing the change the Welsbach light has made in the kind of gas produced, and giving results of photometric tests of Welsbach mantles. 3000 w. Jour Gas Lgt—Sept. 22, 1900. No. 36797 A.

Wood Gas.

Generating Gas from Wood. James M. Neil. Explains the principle of the gas generator invented by H. Riché, of Paris, and gives illustrated description. 900 w. Eng & Min Jour—Sept. 8, 1900. No. 36325.

MARINE AND NAVAL ENGINEERING

Cable-Steamer.

Germany's First Cable-Laying Steamer. Illustrated detailed description of the "Von Podbielski." 2200 w. Sci Am Sup—Sept. 8, 1900. No. 36314.

Colliers.

Twenty Years' Progress in Coal-Carrying Steamers. J. F. Walliker. Abstract of a paper before the Institute of Marine Engineers, reviewing the progress made

in boilers and engines. 2200 w. Ir & Coal Trds Rev—Sept. 7, 1900. No. 36485 A.

Cruiser.

The Imperial Russian Cruiser "Bayan." Illustrates and describes the armoring system, equipment and novel features. 1200 w. Engr, Lond—Aug. 31, 1900. No. 36362 A.

Floating Dock.

The Floating Dock as an Adjunct to a War Navy. Lyonel Clark. Read before the International Congress, at Paris. Discusses the size and construction; the advantages, limitations and cost, making comparison with the graving dock. Ill. 7000 w. Engs' Gaz—Sept., 1900. No. 36364 A.

Japan.

The Nippon Yusen Kaisha. A report concerning the successful operations of the Japan Steamship Co. 1100 w. Engng—Aug. 24, 1900. No. 36240 A.

Light-Ship.

Diamond Shoal Light-Ship. A short description of the staunchest and most thoroughly equipped vessel of her class in the world, to be placed off Cape Hatteras. 600 w. Marine Rev—Sept. 13, 1900. No. 36436.

Marine Engines.

Materials Used in the Construction of Marine Dynamos and Their Engines. Alton D. Adams. Discusses the best material to use in the different parts. 2500 w. Marine Engng—Sept., 1900. No. 36259 C.

Marine Railway.

Great Marine Railway. Splendid New Crandall-designed dry-dock at the Townsend & Downey shipyard, in New York harbor. A description, with illustration, of marine railway and shipyard on Shooter's Island, Newark Bay. 900 w. Naut Gaz—Sept. 20, 1900. No. 36861.

Navigation.

Navigation Interests of Nations. Lyndon W. Bates. Read before International Cong., at Paris. On the value of navigation in advancing international trade and the sense in which it is a national matter, and the duty of the government in regard to public works. 2800 w. Marine Rev—Aug. 30, 1900. No. 36206.

Ocean Records.

The Atlantic Record. Comment on the records of the "Kaiser Wilhelm der Grosse," of the North German Lloyd Co., and the "Deutschland," of the Hamburg-American line, as compared with English vessels. 1700 w. Engr, Lond—Aug. 24, 1900. No. 36246 A.

Oregon.

The Damage to the "Oregon." A description of the damage caused by grounding on a submerged rock in Chinese waters, illustrated from photographs. 600 w. Sci Am—Sept. 29, 1900. No. 36809.

Propulsion.

Modern Steamship Propulsion. W. H. Atherton and A. L. Mellanby. A mathematical discussion of the speed of ships, with diagrams. 1800 w. Pract Eng—Sept. 7, 1900. No. 36450 A.

On the Mechanical Theory of Steamship Propulsion. Robert Mansel. A mathematical discussion. 2500 w. Engr, Lond—Aug. 24, 1900. No. 36243 A.

Reconstruction.

Interesting Ship Repair Work. An account of the lengthening of the hull and the reconstruction of the stern of an Italian passenger and cargo vessel, by the Wallsend Slipway and Engineering Co. 800 w. Engng—Sept. 7, 1900. No. 36459 A.

Sailing Vessels.

The New Era of the American Sailing Vessel. Waldon Fawcett. An illustrated account of large steel sailing vessels and five and six masted wooden schooners recently built at Bath, Me. 2000 w. Sci Am—Sept. 22, 1900. No. 36581.

Types of Sailing Craft. Discusses how they are dressed in different parts of the world, and considers the schooner rig destined to be the sea-going ship of the future. 2400 w. Marine Rev—Aug. 30, 1900. No. 36208.

Steamer.

Mammoth Lake Steamer. Illustration and description of the "Lafayette," one of five new 474-ft. vessels for the Carnegie Line. 1100 w. Naut Gaz—Sept. 6, 1900. No. 36345.

Passenger and Freight Steamer "Hartford." Built for the New York & Hartford Transportation Co. Illustration, with description, of a twin-screw steel vessel of 1,488 gross registered tons and having a cargo capacity of about 300 tons of freight, and accommodations for from 250 to 350 passengers. 1500 w. Marine Engng—Sept., 1900. No. 36258 C.

Stern Wheel Missionary Steamer "Samuel N. Lapsley." Illustrates and describes a light-draft, stern-wheel boat for use on the Congo River. 500 w. Marine Engng—Sept., 1900. No. 36262 C.

The Type of Steamships Years Ago. Illustration and brief description of the "Savannah," the first vessel to cross the Atlantic under steam. 500 w. Am Shipbuilder—Sept. 13, 1900. No. 36304.

Thames Steamboats.

The Thames Passenger Steamboat Service. Reviews the origin and history of the late passenger traffic on this river, the kind of vessels and machinery that

have been in use, etc. Ill. 4000 w. Engr, Lond—Aug. 24, 1900. Serial. 1st part. No. 36245 A.

Torpedo.

Improved Directing Device for Torpedoes (Le Nouvel Appareil Directeur pour Torpilles Automobiles). H. Noalhat. Describing the Whitehead and the Howell torpedoes and the Obry gyroscopic device for guiding the former. 3500 w. Revue Technique—Aug. 25, 1900. No. 36615 D.

Torpedo Boats.

Torpedo Craft—United States and Foreign—Types and Employment. R. H. Jackson. Prize essay read before the U. S. Naval Inst., Annapolis, Ind. 1300 w. Marine Engng—Sept., 1900. Serial. 1st part. No. 36264 C.

Troopship.

Launch of Troopship "Hardinge." A general description of a British troopship, recently launched on the Clyde. 1300 w. Marine Rev—Sept. 13, 1900. No. 36438.

Tugboats.

New Harbor Tugboats. Illustration, with description, of one of the three powerful vessels added to the Pennsylvania R. R. Co.'s fleet. 1300 w. Naut Gaz—Aug. 30, 1900. No. 36219.

Tug "Richard Croker," for Dock Dept., City of New York. Illustration, drawings and description of a steel tug well equipped for harbor service. 1800 w. Marine Engng—Sept., 1900. No. 36260 C.

Ventilator Cowls.

A Practical Geometrical Method of Laying Out Ship Ventilator Cowls. C. M. Jones. Describes method of development. 2000 w. Marine Engng—Sept., 1900. No. 36263 C.

War Vessels.

Best Types of War Vessels. A naval prize essay by Major C. Field, in the *Journal of the Royal United Service Institution,* on the essential requirements and characteristics of fighting ships for the British Navy. 5000 w. Marine Rev—Sept. 20, 1900. No. 36863.

Yachts.

The Clyde and Palatial Steam Yachts. A short general description of Bennett's "Lysistrata" and Drexel's "Margarita," built on the Clyde. 700 w. Engr, Lond—Sept. 14, 1900. No. 36700 A.

The Steam Trials of the New Royal Yacht. A short account of the contract trials of the "Victoria and Albert," with table of results. 1100 w. Engng—Sept. 7, 1900. No. 36458 A.

MECHANICAL ENGINEERING

AUTOMOBILISM.

Congress.

International Automobile Congress. Abstract from report on the details of construction of vehicle frames and their parts made by A. Bollée, Sr., to the third section of the Congress. Touches on piping and pipe joints, loosening of nuts, and the use of aluminum and its alloys. 2000 w. Horseless Age—Sept. 12, 1900. No. 36390.

Electric Control.

Electric Automobile Control. An illustrated description of C. J. Coleman's controlling and driving mechanism. 1200 w. Elec Wld & Engr—Sept. 22, 1900. No. 36718.

Motor.

The Strickland Air-Cooled Motor. An illustrated description of a motor fitted to a tricycle. 400 w. Autocar—Sept. 8, 1900. No. 36527 A.

Postal Wagon.

Automobile Experiments of the German Postal Department. Abstract of an article in *Der Motorwagen,* giving the results of a nine-months' test of an electric vehicle for parcel delivery. 500 w. Horseless Age—Sept. 10, 1900. No. 36526.

Steam Cart.

Steam Tipping-Cart. Illustrated description of a cart made in Leeds, England. 700 w. Sci Am—Sept. 8, 1900. No. 36312.

Steam Dray.

Steam Dray of the Paul H. White Engineering Works. An illustrated description of a steam vehicle with a capacity of 4,000 to 6,000 pounds and a normal speed of five miles an hour. 500 w. Horseless Age—Sept. 19, 1900. No. 36524.

Steam Lorry.

American Built Thornycroft Steam Lorry. Illustrated description of vehicle built in Paterson, N. J. 900 w. Horseless Age—Aug. 29, 1900. No. 36187.

1,000 Mile Trials.

The Thousand-Miles Automobile Trials. W. Worby Beaumont. A critical review of the recent British trials, with illustrations of the principal vehicles, by one of the judges of the competition. 4500 w. Engineering Magazine—Oct., 1900. No. 36935 B.

Transmission.

The Lindsey Gasoline Vehicle. An il-

lustrated description of the vehicle and particularly of the transmission gear. 700 w. Horseless Age—Sept. 19, 1900. No. 36525.

HYDRAULICS.

Centrifugal Pump.

The Centrifugal Emulsion Pump (Note sur les Pompes Centrifuges Emulsives). A. H. Courtois. A description of a modified form of centrifugal pump by which air may be introduced and mixed with the liquid. 2000 w. Revue de Mécanique—Aug., 1900. No. 36642 H.

Furnace Pump.

The Jeanesville Modern Furnace Pump. A short illustrated description of a pump for blast furnace purposes. 700 w. Ir Age—Sept. 20, 1900. No. 36522.

Pumping Engine.

See Steam Engineering.

Pumping Station.

Exposition of 1900. Pumping Station of the French Worthington Company (Exposition de 1900. Usine Elevatoire de la Société Française des Pompes Worthington). E. Cayla. A fully illustrated account of the Worthington pumping plant at the Paris Exposition. 3000 w. 2 plates. Génie Civil—Aug. 18, 1900. No. 36628 D.

MACHINE WORKS AND FOUNDRIES.

Annealing.

On the Annealing of White Cast-Iron. Charles James. An abstract of results obtained from daily business practice. 2800 w. Jour Fr Inst—Sept., 1900. No. 36291 D.

Boring.

A Convenient and Efficient Boring Bar. Illustrates and describes a boring bar and some of the uses to which it may be put. 900 w. Mach, N. Y.—Sept., 1900. No. 36222.

The Beaman & Smith Boring Machines. An illustrated description of three different types of large boring machines. 500 w. Ir Age—Sept. 27, 1900. No. 36755.

Bottle Stoppers.

Dies for Metal Bottle Stoppers. Joseph V. Woodworth. Illustrated detailed description. 1500 w. Am Mach—Sept. 6, 1900. No. 36310.

Cranes.

See Electrical Engineering, Power Applications.

Dividing.

Table for Spacing Holes in Circles. F. W. Seidensticker. A table of sides, angles at center, and sines for inscribed polygons up to 500 sides. 1600 w. Am Mach—Sept. 27, 1900. No. 36820.

Drill Jigs.

Hints on the Design of Drill Jigs and Milling Fixtures. E. H. Dodge. 1400 w. Am Mach—Sept. 6, 1900. No. 36311.

Electric Driving.

See Electrical Engineering, Power Applications.

Emery Wheels.

The Manufacture of Emery Wheels. Illustrates and describes the methods used at the Norton Emery Wheel Co.'s Works at Worcester, Mass. 2500 w. Ir Age—Sept. 6, 1900. No. 36301.

Foundry.

New Steel and Iron Foundry of the Sargent Company. Illustrates and describes the new works at Chicago Heights, and the Tropenas process of making steel. 1300 w. R R Gaz—Aug. 31, 1900. No. 36183.

Gun Making.

The Creusot Pavilion at the Paris Exhibition. An illustrated description of the ordnance and harbor improvement exhibits of Messrs. Schneider & Co. 3000 w. Engng—Sept. 14, 1900. No. 36590 A.

The Home of the Krupp Gun. C. E. Carpenter. A general account of the different Krupp works. 1500 w. Sci Am—Sept. 22, 1900. No. 36584.

The New Army 16-Inch Gun. An illustrated account of this great cannon and its manufacture at Watervliet Arsenal, New York. 1800 w. Sci Am—Sept. 29, 1900. No. 36811.

War Material at the Paris Exhibition. An illustrated account of the display, with comments. 1800 w. Engr, Lond—Aug. 31, 1900. No. 36361 A.

Lathes.

Lathes at the Paris Exhibition. A general review of the exhibit of lathes by all nations. 2100 w. Engng—Sept. 14, 1900. No. 36595 A.

Lathe Work Under a Flood of Water. Illustrates and describes the lathe, and gives examples of work. 1000 w. Am Mach—Sept. 13, 1900. No. 36373.

Mammoth Lathe for Turning Granite Columns. An illustrated description of a lathe which swings 6 feet 6 inches by 60 feet long. 1000 w. Ir Age—Sept. 20, 1900. No. 36520.

Malleable Castings.

Malleable Cast Iron. Outlines the process, giving something of the history of the industry. 3000 w. Eng & Min Jour—Sept. 8, 1900. No. 36322.

Micrometer.

Micrometer Heads for Special Gages. Illustrated description of these heads and various applications. 900 w. Am Mach—Sept. 13, 1900. No. 36374.

New Brown & Sharpe Measuring Instruments. An illustrated description of

micrometer calipers and gauges. 500 w. Ir Age—Sept. 27, 1900. No. 36759.

Mixing.

Mixing Irons. Edward Kirk. Suggestions for thoroughly mixing, and for mixing for a certain grade or class of work. 1500 w. Foundry—Sept., 1900. No. 36293.

Molding.

The Problem of Machine Molding. E. H. Mumford. Prepared for the meeting of the Foundrymen's Assn. Discusses why and how these machines should be used in foundries. 1800 w. Ir Trd Rev—Sept. 6, 1900. No. 36320.

Pipe Flanges.

Standard Pipe Flanges. A table of standard flanges, from the report of a committee of the American Society of Mechanical Engineers. 500 w. Am Mach—Sept. 27, 1900. No. 36816.

Riveting.

Upsetting Cold Steel Rivets by Hydraulic Pressure. Brief illustrated description of method employed in riveting the fly-wheels at the power plant of the Metropolitan St. Ry., in New York. 500 w. Mach, N. Y.—Sept., 1900. No. 36221.

Screws.

Rig for Making Little Screws on a Speed Lathe. Illustrated description. 800 w. Am Mach—Aug. 30, 1900. No. 36188.

Screw Threads.

Notes on the Computation of Screw Threads (Beiträge zur Schraubenberechnung). H. Camerer. With diagrams showing the various stresses and formulas for computation, including the influence of torsion. 2000 w. Zeitschr d Ver Deutscher Ing—Aug. 11, 1900. No. 36601 D.

Shops.

Cincinnati Milling Machine Co.'s Shops. E. M. Chace. Illustrated detailed description of these shops and their management. 2300 w. Mach, N. Y.—Sept., 1900. No. 36220.

Some Methods and Characteristics of a Berlin Tool Shop. Illustrated description of details of shop practice at the works of Ldw. Loewe & Co. 3200 w. Am Mach—Sept. 6, 1900. Serial. 1st part. No. 36309.

Spain.

Machine Tool Trade in Spain. J. H. Ball. Relates the conditions in Spain, and gives practical points on trade. 1700 w. Am Mach—Sept. 27, 1900. No. 36819.

Spiral Gears.

Designing Spiral Gears by the Quadrant Method. W. H. Croker. Descriptive article, with diagrams. 2000 w. Am Mach—Sept. 20, 1900. No. 36588.

Steel Castings.

See Mining and Metallurgy, Iron and Steel.

Tools.

Machine Tools. Part first gives an illustrated description of the exhibit of Smith & Coventry, Limited. 2500 w. Engr, Lond—Aug. 24, 1900. Serial. 1st part. No. 36247 A.

Tools for Interchangeable Work. Joseph V. Woodworth. Part first illustrates and describes a drilling jig. 700 w. Am Mach—Sept. 13, 1900. Serial. 1st part. No. 36375.

Tube-Making.

A New British Tube-making Process. An illustrated account of the Perrin process of making wrought iron tubes, which requires only two heats and two operations. 500 w. Ir & Coal Trds Rev—Sept. 14, 1900. No. 36778 A.

Wire Works.

The British Insulated Wire Co.'s Works at Prescot. Illustrated description of works for the manufacture of paper-insulated cables. 2800 w. Elec Rev, Lond—Aug. 31, 1900. Serial. 1st part. No. 36369 A.

Works Management.

Commercial Organization of the Machine Shop. Hugo Diemer. The fifth paper of Prof. Diemer's series includes the further discussion of the production department, with especial reference to accurate time-keeping. 3000 w. Engineering Magazine—Oct., 1900. No. 36934 B.

MATERIALS OF CONSTRUCTION.

Buckling.

The Correct Formula for Buckling (Die Richtige Knickformel). Correspondence between Messrs. Prandtl, Kriemler, and Kübler, discussing the new buckling formula of the latter engineer. 2000 w. Zeitschr d Ver Deutscher Ing—Aug. 26, 1900. No. 36604 D.

Corrosion.

The Relative Corrosion of Wrought Iron, Soft Steel, and Nickel Steel. Henry M. Howe. Abstract of paper read at the International Congress on "Methods of Testing the Materials of Construction," giving the results of experiments. 1800 w. Ir & Coal Trds Rev—Sept. 7, 1900. No. 36486 A.

Deformation.

Permanent Deformation of Metals. From a paper entitled *Phénomènes qui accompagnent la déformation permanente des métaux*, by Commander Hartmann, written for the Paris International Congress on Mining and Metallurgy. 2400 w. Col Guard—Sept. 7, 1900. No. 36445 A.

Stresses.

Ring Stresses and Tension Strength (Ringspaunungen und Zugfestigkeit). M. Grübler. An examination of the relation between the tension resistance and the stresses in a ring, with especial reference to the researches of Professor Bach. 6000 w. Zeitschr d Ver Deutscher Ing—Sept. 1, 1900. No. 36606 D.

POWER AND TRANSMISSION.

Air Compressor.

An Auxiliary Air Compressor for Steam Engines. An illustrated description of a compressor manufactured by the Sedgwick-Fisher Co., which can be conveniently and economically operated by the steam engine which supplies the motive power for a plant. 700 w. Eng News—Sept. 20, 1900. No. 36572.

The Use of Water Powers by Direct Air Compression. W. O. Webber. The revival of an old application by which a high efficiency is attained with simplicity of mechanism. 2500 w. Engineering Magazine—Oct., 1900. No. 36692 B.

Air Transmission.

Compressed Air for the Transmission of Power. J. H. Ronaldson. A paper before the New South Wales Chamber of Mines, giving a general discussion of compressed air, compressors, and methods of use. 3400 w. Col Guard—Sept. 14, 1900. No. 36768 A.

Compressed Air for Transmission of Power. J. H. Ronaldson. An account of the principles and the machinery employed. 2800 w. Aust Min Stand—July 26, 1900. No. 36382 B.

Conveyors.

Coal Handling Machinery. F. D. Marshall. A paper before the International Gas Congress at Paris, giving an illustrated account of Hunt conveying machinery used by Danish Gas Company at Copenhagen. 3000 w. Gas Wld—Sept. 8, 1900. No. 36475 A.

Continental Installations of the Hunt Transporter for Coal and Ore. From a paper by Engineer Aumond, before the German Ironmasters' Association, giving an illustrated account of the installation of this machinery of American design at various Continental works. 2000 w. Col Guard—Sept. 7, 1900. No. 36439 A.

Power Generation.

Power Generation. The Comparative Cost of Generating Power by the Steam Engine, Water Turbine and Gas Engine. J. B. C. Kershaw. Paper before the British Association, with elaborate data and tables. Serial. 1st part. 2500 w. Engng—Sept. 14, 1900. No. 36599 A.

Transporter.

A Phosphate Transporter at Sfax. An illustrated description of a mechanical transporting plant which carries phosphate from stores and wagons to vessels at Sfax, Tunisia. 1100 w. Sci Am—Sept. 29, 1900. No. 36808.

SPECIAL MOTORS.

Banki Motor.

Tests of the Banki Motor (Versuche am Banki-Motor). E. Meyer. A discussion of the data and results of this new internal combustion motor, showing the excellent results obtained. Illustrations showing the construction of the motor are given. 5000 w. Zeitschr d Ver Deutscher Ing—Aug. 11, 1900. No. 36600 D.

The Banki Motor and Other Heat Motors (Der Banki Motor und die Wärmemotoren). E. Schimanek. A general description of the Banki internal-combination motor, and a comparison of its performance with other motors; based on the recent tests. Three articles, 12000 w. Zeitschr d Oesterr Ing u Arch Ver—Aug. 10, 17, 24, 1900. No. 36620 each B.

Diesel Motor.

New Experiments on the Diesel Oil Engine. A short summary of tests at Augsburg, abstracted from a paper by Mr. Diesel at the Congrès de Mecanique at Paris. 900 w. Engng—Sept. 7, 1900. No. 36457 A.

Explosion Motors.

Explosion Motors at the Paris Exposition (Die Weltausstellung in Paris, 1900; Explosionsmotoren). Fr. Freytag. With numerous illustrations and descriptions of exhibited motors. Serial, part I. 2500 w. Zeitschr d Ver Deutscher Ing—Aug. 18, 1900. No. 36602 D.

Gas Engine.

A 600-H.-P. Two-stroke Cycle Gas Engine Using Blast-Furnace Gas. A well illustrated description, from the *Zeitschrift des Vereines Deutscher Ingenieure* of a gas engine using blast furnace gas. 1 plate. 1500 w. Eng News—Sept. 27, 1900. No. 36842.

Some Existing Gas-Driven Power Plants. Philip Dawson. A well illustrated article on the application of gas engines to drive electric power plants. Serial. 1st part. 1400 w. Engng—Sept. 7, 1900. No. 36451 A.

The Determination of the Efficiency of Port Valves of 4-Cycle Internal Heat Engines. Hugh D. Meier. A general discussion, and record of experimental tests, with indicator cards. 3000 w. Horseless Age—Sept. 19, 1900. No. 36523.

The Theory of Gas Engines (Essai sur la Theorie des Moteurs à Gaz). Jules Deschamps. An elaborate mathematical study, based upon the theory of Clausius. Serial, Part I. Revue de Mecanique—July, 1900. No. 36639 H.

Ignition.

Electrical Ignition of Gas Engines. H. J. Poddlesak. Discusses the methods of igniting the charges in a gas engine, especially favoring the inductor type of magneto-generators as a source of electric current for gas and vapor engine ignition. 4000 w. Mod Mach—Sept., 1900. No. 36256.

STEAM ENGINEERING.

Balancing.

Balancing of Vertical Marine Engines Discussed in an Elementary Manner. J. Macfarlane Gray. Read before the Inst. of Marine Engs., London, Eng. Ill. 3000 w. Marine Engng—Sept., 1900. Serial. 1st part. No. 36261 C.

Boilers.

Defects Experienced in Belleville Boilers in the British Navy. An Admiralty statement as to the chief defects which have been experienced in the working of these boilers. 1000 w. Eng News—Sept. 20, 1900. No. 36547.

Double Steam Boiler with Conical Flues (Zwillings-Dampfkessel mit Conischem Stufenrohr). An illustrated description of an improved form of Lancashire boiler, exhibited at Paris. 800 w. Glaser's Annalen—Aug. 15, 1900. No. 36654 D.

The Boilers of the Paris Exposition. Illustrated detailed description of interesting exhibits. 5500 w. Power—Sept., 1900. No. 36181.

Boiler Tubes.

See Railway Affairs, Motive Power.

Calorimeter.

A New Form of Calorimeter for Measuring the Wetness of Steam. Prof. John Goodman. A paper before the British Association, giving an illustrated description of a continuous condensing calorimeter using only one scale beam. 2500 w. Col Guard—Sept. 14, 1900. No. 36764 A.

Chimneys.

Chimneys and Stacks for Steam Boilers. W. H. Wakeman. Calculations concerning chimney draft, with explanation. 3500 w. Mod Mach—Sept., 1900. No. 36257.

Coal Pockets.

The Design of Coal Pockets. Illustrated outline of the method of design adopted for the large power station of the Metropolitan Street Ry. in New York. 800 w. Eng Rec—Sept. 1, 1900. No. 36202.

Compression.

I. Regarding Effect of Compression in Steam Cylinders on Economy. B. C. Ball. II. On the Compression of Back-Pressure Steam Into the Waste Space of Cylinders. B. F. Isherwood. A criticism of reported tests, and a reply. 5000 w. Jour Am Soc of Nav Engs—Aug. 1, 1900. No. 36372 H.

Condensers.

Centralization of the Steam-Condensing Plant. H. G. V. Oldham. The first instalment of a very fully illustrated description of modern cooling towers, evaporative condensers, and general arrangement of central condensing plant. 4000 w. Engineering Magazine—Oct., 1900. No. 36693 B.

Cooling Tower.

A Cooling Tower Operating with Natural Draft. An illustrated description of a cooling tower brought out by the Wheeler Condenser & Engineering Co., which will cool water from 135° F. to 85° or 90° F. 200 w. Eng News—Sept. 27, 1900. No. 36845.

Corrosion.

Corrosion of Boiler Tubes in the United States Navy. Walter F. Worthington. Discusses the reasons usually assigned for the corrosion of boiler tubes, and gives results of experiments to determine the difference in corrodibility between the usual materials used, and general conclusions. Ill. 5400 w. Jour Am Soc of Nav Engs—Aug., 1900. No. 36371 H.

Economy.

See Electrical Engineering, Generating Stations.

Engines.

High Power Single-Cylinder Engines at the Paris Exhibition. E. Kilburn Scott. A short account of some large engines coupled to alternators. 700 w. Elec Rev, Lond—Sept. 7, 1900. No. 36498 A.

Some Notes on Inquiries for Engines. J. A. Seager. Suggestions for guidance and to facilitate the delivery of a satisfactory engine. 2200 w. Am Gas Lgt Jour—Sept. 3, 1900. No. 36280.

Steam Engines at the Paris Exposition (Die Weltausstellung in Paris, 1900; Die Dampfmaschinen). M. F. Gutermuth. A general review of the exhibited engines, with table showing varieties. Serial, Part I. 3500 w. Zeitschr d Ver Deutscher Ing—Sept. 1, 1900. No. 36605 D.

The Steam Engine. William Frederick Durand. An elementary discussion of the principles which govern the economical use of steam for the development of power. 3500 w. Marine Engng—Sept., 1900. Serial. 1st part. No. 36265 C.

The Sulzer Exhibit at the Paris Exhibition. A short illustrated description of some Sulzer engines, including a four-cylinder, triple-expansion one of 1,700 horse-power. 400 w. Elec Rev, Lond—Sep. 14, 1900. No. 36735 A.

Nigzell's Double Triple-Expansion Engine. An illustrated account of tests of a very well balanced engine, with diagrams. 2500 w. Engng—Sep. 7, 1900. No. 36460 A.

Exhaust-Steam.

Cooling with Exhaust Steam. Alton D. Adams. Discusses its utilization in the manufacture of ice or in the cooling of apartments near the steam plants. 2000 w. Am Arch—Sept. 1, 1900. No. 36253.

Exposition.

Power Plant at the Paris Exhibition. A well illustrated account of the exhibits in Machinery Hall. 10000 w. Ir & Coal Trds Rev—Sept. 7, 1900. No. 36487 A.

The Paris Exhibition Electric Power Station. The exhibits of Messrs. Escher, Wyss & Co., and Maschinenfabrik Oerlikon. A well illustrated description of a 1,000-horse-power horizontal engine, coupled with a triphase generator. 700 w. Engng—Sept. 7, 1900. No. 36454 A.

Feed-Heater.

The "Warwick" Feed-Heater and Detartariser. An illustrated description of a feed water heater and purifier. 300 w. Engng—Sept. 14, 1900. No. 36596 A.

Indicator.

The Indicator and Revealer (Indicateur-Revelateur). G. Duchesne. A description of the method of testing the indicators used in the mechanical laboratory of the University of Liège; also of the revealer of Mr. Bryan Donkin for indicating the moisture in a steam cylinder. 4000 w. Revue de Mécanique—Aug., 1900. No. 36640 H.

Petroleum Fuel.

California Crude Petroleum as a Fuel. Ernest H. Denicke. Gives methods of burning oil and results of practical experience. Serial. 1st part. 2000 w. Min & Scien Press—Sept. 15, 1900. No. 36529.

Pulverized Coal.

The Burning of Pulverized Coal. Describes the use of pulverized coal in rotary kilns for burning Portland cement, and advocates its use under steam boilers. 600 w. Eng Rec—Sep. 15, 1900. No. 36415.

Pumping Engine.

Allis Triple-Expansion Pumping Engine, Chestnut Hill Station, Boston Water-Works. A brief illustrated description of a notable large high-duty engine. 1 plate. 250 w. Eng News—Sept. 27, 1900. No. 36850.

The Conditions of Maximum Pumping Engine Economy. A discussion of some recent tests of Allis and Nordberg engines, giving remarkable duty records; with tables. 4000 w. Eng News—Sept. 27, 1900. No. 36848.

Reciprocating Parts.

The Inertia of the Reciprocating Parts of a Steam Engine. C. H. Benjamin. The object of the article is to show the method of determining the excess and deficiency of energy for different speeds and points of cut-off. 2700 w. Mach, N. Y.—Sept., 1900. No. 36223.

Steam Turbines.

Report on Steam Turbines (Rapport sur les Turbines à Vapeur). M. Rateau. A paper presented at the Congrès de Mécanique at Paris, discussing mainly jet turbines of the de Laval type. 15000 w. Revue de Mécanique—August, 1900. No. 36643 H.

Stoking.

Mechanical Stoking. Illustrated description of the Playford mechanical stoker is given in part first. 1200 w. Sci Am Sup—Sept. 15, 1900. Serial. 1st part. No. 36387.

The Roney Mechanical Stoker. A well illustrated description of the improved form of this apparatus, which is to equip boiler plants of an aggregate of over 225,000 horse-power in the United States. 1000 w. Sci Am Sup—Sept. 22, 1900. No. 36585.

Notes on Firing (Etwas über Füllfeuerungen). Ed. Brauss. Gives various practical hints on fuel, furnaces, chimneys, etc. 1500 w. Gesundh Ing—July 15, 1900. No. 36558 B.

Thermodynamics.

Mean Effective Temperature a Unit of Comparison for Heat Engines. Chas. E. Lucke. A mathematical discussion of different cycles, with diagrams. 2000 w. School of Mines Quar—July, 1900. No. 36541 D.

Valve.

A New Balanced Piston-Valve and Its Application to Four-Crank Engines. Wm. O'Brien. Discussion of a paper before the Institution of Engineers and Shipbuilders in Scotland, at Glasgow. 700 w. Ir & Steel Trds Jour—Sept. 15, 1900. No. 36782 A.

Variable Load.

The Law of Averages—Simple vs. Compound Engines under Variable Load. W. H. Booth. A discussion of the relative advantages of single and compound engines under variable loads. 2300 w. Am Mach—Sept. 27, 1900. No. 36817.

MISCELLANY.

Air Ship.

The Zeppelin Air Ship as the Latest Experiment with Dirigible Balloons (Das Zeppelin Luftschiff als Neuester Versuch zur Lenkbarmachung von Gasballons). H. von Loessl. A general review of the attempts which have been made to steer gas

balloons, with reference to the recent experiments of Zeppelin. 3500 w. Zeitschr d Oesterr Ing u Arch Ver—Aug. 31, 1900. No. 36623 B.

British Association.

The British Association. Abstracts of the papers read in the Mechanical Science section at the Bradford meeting. 6000 w. Engng—Sept. 14, 1900. No. 36591 A.

The British Association. Address to the Mechanical Science section. Sir Alexander R. Binnie, President of Section. A historical review of mechanical science. Serial. 1st part. 2500 w. Engng—Sept. 7, 1900. No. 36461 A.

Competition.

American Engineering Competition. Notes on a series of articles recently published in the London *Times*. 2700 w. Jour Gas Lgt—Aug. 28, 1900. Serial. 1st part. No. 36249 A.

Liquid Air.

Linde's Liquid Air Machine. Alfred Siebert. How the machine operates to produce liquefaction, etc. 2300 w. Ice & Refrig—Sept., 1900. No. 36225 C.

Manufactories.

The Engineer, and the Economical Development of Manufactories. W. Arnold. Read before the Birmingham Assoc. of Engs., England. On the means of increasing the output and thus enabling England to compete with other countries. 6000 w. Engr, Lond—Aug. 31, 1900. No. 36363 A.

Mills.

The Origin of the Grinding Mill (Les Origines du Moulin à Grains). M. L. Lindet. A historical review with many illustrations of ancient and primitive mills. 12000 w. Bull Soc d'Encour—Aug., 1900. No. 36636 G.

Refrigeration.

A Brooklyn Refrigerating Plant. Illustrated description of the mechanical plant and insulating details of the building of a large cold-storage company. The plant provides for ventilation as well as refrigeration. 3500 w. Eng Rec—Sept. 1, 1900. No. 36203.

St. Louis Refrigerating and Cold Storage Co. Description of a new up-to-date plant, with exterior and interior views. 3800 w. Ice & Refrig—Sept., 1900. No. 36224 C.

Technical Education.

Chemical and Technical Education in the United States. Prof. C. F. Chandler. Presidential address before the Society of Chemical Industry, at London. Serial. 1st part. 7000 w. Sci Am Sup—Sept. 29, 1900. No. 36813.

Vibrations.

Mechanical-Technical Recreations (Mechanisch-Technisch Plaudereien). Dr. Holzmüller. A popular examination of the phenomena of vibration in connection with heat, illustrated with diagrams and formulas. 6000 w. Zeitschr d Ver Deutscher Ing—Aug. 18, 1900. No. 36603 D.

MINING AND METALLURGY

COAL AND COKE.

American Exports.

Exports of American Coal. The possibilities of the upbuilding of an immense trade pointed out by F. E. Saward, special U. S. Commissioner at Paris. 5000 w. Marine Rev—Sept. 20, 1900. No. 36862.

British Association.

Coal at the British Association. Abstracts of the principal papers relating to coal, such as, "The Origin of Coal," "Coal and Iron in China," etc. 3300 w. Ir & Coal Trds Rev—Sept. 14, 1900. No. 36775 A.

British Exports.

Coal and Iron Exports. An editorial giving figures for the British export trade in coal and iron for August, 1900, and for the first eight months of 1900. 500 w. Col Guard—Sept. 14, 1900. No. 36766 A.

Canada.

Canadian Mining Notes. A review of coal and iron ore production and trade. 1100 w. Col Guard—Sept. 14, 1900. No. 36770 A.

China.

The Coal and Iron Deposits of Shansi and Honan, China. J. G. H. Glass. Summary of a paper before the British Association, giving a description of the bituminous and anthracite coal fields of Shansi and Honan, existing means of communication, etc. 800 w. Col Guard—Sept. 14, 1900. No. 36773 A.

Coal-Cutting.

Some Difficulties of Electric Coal-Cutting. A detailed account of an attempt to cut coal by means of electric power in a Cape Colonial mine. 2000 w. Col Guard—Sept. 7, 1900. No. 36440 A.

Coal Question.

Coal Owners, Gas Companies, and the Coal Question. Concerning the scarcity of coal and high prices in England and on the Continent, and the importation of American coal. 1800 w. Jour Gas Lgt—Aug. 28, 1900. No. 36285 A.

Coal Supply.

The Coal Situation and the World's Coal Fields (La Crise du Charbon). A review of coal fields of the world, particularly new ones, and a consideration of international coal trade and transportation. 1000 w. Moniteur Industriel—June 9, 1900. No. 36569 E.

The World's Need of Coal and the United States' Supplies. F. E. Saward. A review of the changing conditions in the coal production of the world, showing the assured supply from the United States. 3500 w. Engineering Magazine—Oct., 1900. No. 36688 B.

Coke.

History of Connellsville Coke. F. C. Kieghley. Read before the Cent. Min. Inst. of W. Penna. 3200 w. Foundry—Sept., 1900. No. 36294.

Mining Methods in the Connellsville Coke Region. F. C. Keighley. A fully illustrated account of the Pennsylvania coke industry, showing its importance as a factor in the production of iron. 4000 w. Engineering Magazine—Oct., 1900. No. 36690 B.

The Desulphurization of Coke. A general review of attempts to devise a satisfactory treatment. 1700 w. Engr, Lond—Sept. 7, 1900. No. 36462 A.

The Future of the Connellsville Coke Region. A review of conditions there and a discussion of length of time before the coal is exhausted. 800 w. Eng & Min Jour—Sept. 22, 1900. No. 36754.

Coke Ovens.

The Brunck Coke Ovens. R. Brunck, in *Stahl und Eisen*. Illustrated description, showing the method of packing in coal, and improvements in the recovery of gases and by-products. 1800 w. Am Mfr & Ir Wld—Sept. 6, 1900. No. 36328.

Colliers.

See Marine Engineering.

Colliery Managers.

The National Association of Colliery Managers. An account of the annual meeting at Sheffield, Eng., and the presidential address of John Knowles, reviewing the coal mining industry of Great Britain. 3000 w. Col Guard—Sept. 14, 1900. No. 36765 A.

English Collieries.

The Langwith and Clapwell Collieries. A general illustrated description of works near Chesterfield. 1700 w. Col Guard—Sept. 7, 1900. No. 36444 A.

Exposition.

Bruay Colliery at the Paris Exhibition. Illustrated description of a complete working model exhibited. 4300 w. Col Guard—Aug. 31, 1900. No. 36356 A.

Dourges Colliery at the Paris Exhibition. An illustrated description of a variety of colliery apparatus exhibited by the Société des Mines de Dourges, in the department of Pas-de-Calais. 4000 w. Col Guard—Sept. 7, 1900. No. 36443 A.

France.

The Hard Coal Mines of Northern France (Der Nord französische Stein Kohlenbergbau). F. Drobniak. With some account of the methods of mining and timbering. 2000 w. 1 plate. Oesterr Zeitschr f Berg u Hüttenwesen—Aug. 25, 1900. No. 36673 B.

Fuel.

The Fuel Question in Sweden. A résumé of interesting articles on this subject which have appeared recently in the Swedish press. 1800 w. Engr, Lond—Aug. 31, 1900. No. 36360 A.

German.

The German Coal Industry. A review of the condition of the German coal industry during the past few months, when scarcity and high prices have prevailed. 2500 w. Col Guard—Sept. 14, 1900. No. 36769 A.

Haulage.

Electrical Coke Lorries. An illustrated description, with figures, showing the economy over horse haulage. 500 w. Ir & Coal Trds Rev—Sept. 7, 1900. No. 30484 A.

Electric Locomotives in Coal-Mining. An illustrated account of electric haulage at some Pennsylvania coal mines. 3400 w. Engng—Sept. 7, 1900. No. 36452 A.

Endless Rope Haulage at Pratt Mines. Illustrated description of a system installed in a mine at Ensley, Ala. 2700 w. Ir Trd Rev—Aug. 30, 1900. No. 36180.

Notes on the Compressed-Air Haulage-Plant at No. 6 Colliery of the Susquehanna Coal Company, Glen Lyon, Pennsylvania. J. H. Bowden. Descriptive. 1500 w. Trans Am Inst of Min Engs—Aug., 1900. No. 36339 D.

Kentucky.

The Kentucky Coalfields. Capt. C. C. Longridge. A general account of the fields, the character of the coal, the markets and transportation. 2000 w. Col Guard—Sept. 7, 1900. No. 36441 A.

Labor.

The Anthracite Coal Case. A discussion of the relative positions of miners and operators, with statistics. 2200 w. Eng & Min Jour—Sept. 29, 1900. No. 36855.

Lignite.

The Lignite Industry of the Cologne District (Die Braunkohlenindustrie des Kölner Bezirkes). H. Schott. A paper before the Society of German Engineers, giving a review of the production of lignite and the extent to which it has been used in Germany and elsewhere. 3000 w.

Zeitschr d Ver Deutscher Ing—Sept. 1, 1900. No. 36609 D.

Mine Maps.

Coal Mine Maps. L. C. Morganroth. An account of the systematizing of the maps of a large company. 1900 w. Eng & Min Jour—Sept. 29, 1900. No. 36857.

Origin.

The Conditions Under Which the Plants of the Coal Period Grew. A summary of papers read before the British Association, at Bradford, on the origin of coal, coal-period flora, etc. 3500 w. Col Guard—Sept. 14, 1900. No. 36771 A.

Outcrops.

Coal-Outcrops. Charles Catlett. Observations based on personal examinations. 1200 w. Trans Am Inst of Min Engs—Aug., 1900. No. 36338 D.

Poland.

The Production of Coal in the Dombrowa Region, Poland, for 1899 (L'Extraction Houillère du Bassin de Dombrowa (Pologne) en 1899). Official tables, taken from the *Torgovo-Promychlénaiä Gazeta*, giving figures for 1898 and 1899. 800 w. Moniteur Industriel—July 28, 1900. No. 36840 E.

Rhodesia.

Rhodesia's Coal Supply. A brief account of the Wankie coalfield. 300 w. Ir & Coal Trds Rev—Sept. 14, 1900. No. 36777 A.

Rib-Drawing.

Some Practical Remarks on Ribs and Rib-Drawing. W. S. Gresley. Considers the uneconomical and undesirable features attending taking out ribs and pillars. 4000 w. Eng & Min Jour—Sept. 1, 1900. No. 36213.

Silted Pipes.

Cleaning Silted Pipes. J. R. Wilkinson. Read before the Col. Mgrs. Assn. Deals with deposits more or less plastic, usually deposited from cold water in the rising mains of pumps or pipes. Ill. 1800 w. Ir & Coal Trds Rev—Aug. 31, 1900. No. 36355 A.

Staffordshire.

The Thickness and Character of the Coal Measures of North Staffordshire. W. Gibson. Summary of a paper before the British Association. 500 w. Col Guard—Sept. 14, 1900. No. 36774 A.

Survey.

The Geological Survey of the North Staffordshire Coalfield. Report of recent work, showing progress made. 3300 w. Col Guard—Aug. 31, 1900. No. 36358 A.

Trade.

The Coal Trade of the United States and the World's Coal Supply and Trade. Abstract from the Summary for Commerce and Statistics, of U. S. Bureau of Statistics, for April, 1900, with diagram. 5000 w. Sci Am Sup—Sept. 22, 1900. No. 36587.

Wales.

The Geological Survey of the South Wales Coalfield. From the Summary of Progress of the Geological Survey of the United Kingdom for 1899. 5000 w. Col Guard—Sept. 7, 1900. No. 36442 A.

COPPER.

Arizona.

An Arizona Copper Exhibit at Paris. A description of several Arizona copper mines, their ores and smelters. 1600 w. Eng & Min Jour—Sept. 22, 1900. No. 36750.

Assaying.

The Assay of Copper Materials for Gold and Silver. L. D. Godshall. Discussion of this paper, which was presented at the Washington meeting, Feb., 1900. 1500 w. Trans Am Inst of Min Engs—Aug., 1900. No. 36344 D.

The Assay of Copper Materials for Gold and Silver. A. R. Ledoux. Criticism of a paper read by L. D. Godshall before the American Institute of Mining Engineers, and a description of the "combination method" used in assaying bar copper for silver. 1000 w. Eng & Min Jour—Sept. 15, 1900. No. 36410.

The Calorimetric Assay of Copper. J. D. Audley Smith. Gives details of method. 1000 w. Trans Am Inst of Min Engs—Aug., 1900. No. 36341 D.

The Calorimetric Assay of Copper. J. D. Audley Smith. Abstract of paper read at the Canadian meeting of the American Institute of Mining Engineers, describing a method of making a fresh set of standard colors for each batch of assays in the Heine "blue test" for copper. 1000 w. Eng & Min Jour—Sept. 15, 1900. No. 36409.

The Rapid Determination of Copper and Nickel in Sulphide Ores and Matte. Titus Ulke. A description of a method of analysis. 1000 w. Eng & Min Jour—Sept. 15, 1900. No. 36405.

Australia.

South Australian Mines. W. H. Mathews. The Inspector of Mines' report on the Poona and Mattapara copper mines, Paull's Consolidated Copper Proprietary and the Nilpena Copper Mine. 1200 w. Aust Min Stand—Aug. 2, 1900. No. 36384 B.

Deposits.

Types of Copper Deposits in the Southern United States. Walter H. Weed. An account of the copper resources of this region, describing examples of each type.

Ill. 17500 w. Trans Am Inst of Min Engs—Aug., 1900. No. 36342 D.

The Origin of the Native Copper in the Michigan Deposits. John F. Blandy. The writer's views as to the origin, and information relating to these deposits. 2000 w. Eng & Min Jour—Sept. 8, 1900. No. 36324.

Yukon.

Notes on the White Horse Copper Belt, Yukon Territory. R. H. Stretch. An account of the general surroundings and geological features. 2700 w. Eng & Min Jour—Sept. 8, 1900. No. 36323.

GOLD AND SILVER.

Amalgamation.

The Bryan Mill as a Crusher and Amalgamator Compared with the Stamp Battery. E. A. H. Tays. Discussion of this paper, which was presented at the California meeting, Sept., 1899. 700 w. Trans Am Inst of Min Engs—Aug., 1900. No. 36343 D.

Australia.

Phillips River Goldfield (W. Aus.). T. Blatchford. Extracts from the official report to the Mines Dept. on the geology of this district. 1700 w. Aust Min Stand—Aug. 2, 1900. Serial. 1st part. No. 36-385 B.

Brazil.

Notes on Certain Schists of the Gold and Diamond Regions of Eastern Minas Geraes, Brazil. Orville A. Derby. Describes these deposits, giving analyses and discussing their origin. 4500 w. Am Jour of Sci—Sept., 1900. No. 36287 D.

British Columbia.

Notes from the Atlin District, British Columbia. W. M. Brook. An illustrated account of work on this gold field. 1200 w. Eng & Min Jour—Sept. 15, 1900. No. 36407.

The Quartz Lodes of the Atlin District, B. C. R. H. Stretch. A general description, with maps. 3200 w. Eng & Min Jour—Sept. 29, 1900. No. 36859.

Cyaniding.

Some Further Mill Practice in Cyaniding the Silicious Ores of the Black Hills, South Dakota. J. M. Henton. An account of operations at the mill of the Dakota M. & M. Co., at Central City. 1600 w. Mining & Scien Press—Sept. 8, 1900. No. 36448.

The Cyanide Works of the Liberty Bell Gold Mining Company, Colorado. F. L. Bosqui. An illustrated account of a cyanide plant with a capacity of 240 tons per day, with cost of operation. 900 w. Eng & Min Jour—Sept. 22, 1900. No. 36751.

Dredging.

Gold Dredging Experience in New Zealand. A description of some working devices, and results of operations. 1000 w. Min Reporter—Sept. 13, 1900. No. 36530.

Georgia.

The Columbia Mining Company, Georgia. W. H. Fluker. An illustrated accounts of some Georgia gold mines. 1000 w. Eng & Min Jour—Sept. 22, 1900. No. 36752.

Nova Scotia.

Gold Mining in Nova Scotia. G. W. Stuart. A brief history of the industry, with illustrations. 2600 w. Eng & Min Jour—Sept. 15, 1900. No. 36413.

Old Mine.

The Oldest Gold Mining Camp. Theo. Van Wagenen. An illustrated account of some old gold workings on the California bank of the Colorado River, dating from the last century. 2000 w. Mining & Scien Press—Sept. 8, 1900. No. 36446.

Ontario.

The Gold-Fields of Western Ontario. J. D. Lowry. An account of the deposits, development, advantages, and other information. 1500 w. Eng & Min Jour—Sept. 1, 1900. No. 36212.

Pumping Plant.

Hydraulic Pumping-Plant on the Snake River, Idaho, for Power, Irrigation, and the Treatment of Gold Sands. John Birkinbine. Notes suggesting the application of available water power. 2000 w. Trans Am Inst of Min Engs—Aug., 1900. No. 36332 D.

Scorification.

Experiments Regarding the Influence of Silica on the Loss of Silver in Scorification. Lester Strauss. An account of experiments made and conclusions reached. 1600 w. Trans Am Inst of Min Engs—Aug., 1900. No. 36334 D.

Transvaal.

The Treatment of Gold Ore at the Transvaal Exhibit at the Trocadero. An illustrated account of a very interesting exhibit made by the government of the South African Republic. 1700 w. Sci Am Sup—Sept. 8, 1900. No. 36315.

Zinc-Bearing.

The Sadtler Process for Treating Zinc-Bearing Ores. A description of a process for the recovery of gold, silver, etc., from zinc-bearing ores. 2200 w. Eng & Min Jour—Sept. 29, 1900. No. 36858.

IRON AND STEEL.

Blast Furnaces.

Condition of the Blast Furnaces of the United States, September 1, 1900. Tables giving various statistics. 1000 w. Am Mfr & Iron Wld—Sept. 13, 1900. No. 36-430.

British Trade.

Our Foreign Trade in Iron and Steel. Editorial on British imports and exports of iron and steel for the first eight months of 1899 and 1900. 900 w. Ir & Coal Trds Rev—Sept. 14, 1900. No. 36779 A.

Canada.

Canada as a Future Competitor in Coal and Iron. Concerning the iron ore resources of Nova Scotia and Ontario. 2200 w. Ir & Coal Trd Rev—Aug. 24, 1900. No. 36241 A.

Steel Shipments to Seaboard by All-Water Route. A discussion of the probable traffic between the Great Lakes and the seaboard, by way of the Canadian Waterways. 1700 w. Ir Trd Rev—Sept. 20, 1900. No. 36785.

China.

The Han-yang Steel Works, China. F. Lynwood Garrison. An account of the only iron and steel works of any importance in China, with illustration. 1000 w. Ir Age—Sept. 13, 1900. No. 36376.

Development.

National Ideals the Prime Influence in Iron Trade Development. H. J. Skelton. A discussion of the close relations between political and social order and the development of the iron trade. 3500 w. Engineering Magazine—Oct., 1900. No. 36689 B.

Export.

Reaching for Export Business. Pittsburg iron and steel producers finding the way to reach the world's markets via the Welland Canal and the St. Lawrence River. 700 w. Am Mfr & Iron Wld—Sept. 13, 1900. No. 36434.

Exposition.

British Iron Trade Association. Report of the Secretary on Iron and Steel at the Paris Exhibition. A full report on the metallurgical and kindred exhibits at the Paris Exposition. Serial. 1st part. 8000 w. Ir & Coal Trds Rev—Sept. 14, 1900. No. 36780 A.

Paris Exposition—Exhibits in the Metallurgical Section. An illustrated account of various exhibits, principally iron and steel. 1500 w. Sci Am Sup—Sept. 29, 1900. No. 36812.

Furnace-Linings.

The Protection of Blast-Furnace Linings. S. S. Hartranft. Discussion of the best management, and comments on American practice. 1500 w. Trans Am Inst of Min Engs—Aug., 1900. No. 36336 D.

Iron Metallurgy.

Present State of Iron Metallurgy. From a communication to the *Revue Générale des Sciences*, by Emile Demenge, reviewing modern methods in metallurgy. 2200 w. Col Guard—Sept. 14, 1900. No. 36767 A.

Lake Superior.

Lake Iron Ore Matters. A Duluth letter discussing mines, prices, shipments, etc. 1500 w. Ir Age—Sept. 27, 1900. No. 36758.

Micrography.

The Causes of Fracture of Steel Rails. An illustrated abstract of the report of a Board of Trade Committee of Investigation into the loss of strength of steel rails by prolonged use, particularly the microscopical examination of a broken rail. 1200 w. Nature, Lond—Sept. 6, 1900. No. 36449 A.

Nova Scotia.

The Outlook for an Iron and Steel Industry in Nova Scotia. A discussion of present conditions and future developments. 2200 w. Eng News—Sept. 13, 1900. No. 36420.

New South Wales.

Iron Ore in New South Wales. Extracts from a preliminary report by J. B. Jaquet, Geological Surveyor to the New South Wales Mines Department, upon deposits of iron ore in the Carcoar district. 1000 w. Col Guard—Sept. 14, 1900. No. 36772 A.

Nickel Steel.

Nickel Steel at the Exposition of 1900 (Les Aciers à Nickel à l'Exposition de 1900). A. Abraham. An account of the exhibits at Paris, and a discussion of the researches of M. Guillaume. 3000 w. Génie Civil—Aug. 11, 1900. No. 36626 D.

Norway.

The Possibility of an Iron Industry in Norway. H. C. Carpenter. A review of Prof. J. H. L. Vogt's estimate of the cost of making pig-iron in Norway. 1000 w. Eng & Min Jour—Sept. 29, 1900. No. 36860.

Open-Hearth.

Development in Open-Hearth Steel. R. C. Lauth. Suggestions that might lead to great results in cheapening the cost. 2000 w. Am Mfr & Ir Wld—Sept. 6, 1900. No. 36329.

Ores.

The Clealum Iron-Ores, Washington. George O. Smith and Bailey Willis. Gives the general features, geology, and hypothesis concerning the origin, with short discussion. Map. 3300 w. Trans Am Inst of Min Engs—Aug., 1900. No. 36331 D.

Pig Iron.

A Device for Sampling Pig-Iron. Porter M. Shimer. A paper read before the American Institute of Mining Engineers, giving an illustrated description

of a small cup, fitted to a break-drill, to catch the drillings. 400 w. Eng News—Sept. 27, 1900. No. 36847.

Distribution of the World's Production of Pig-Iron. John Birkinbine. A statement giving a general idea of amounts as compiled from latest official records, of ores, iron, and metals produced in the various countries that contribute to the output. 6000 w. Trans Am Inst of Min Engs—Aug., 1900. No. 36333 D.

Pig Iron Production, Prices and Prospects. Tables and curves showing statistics for the last three years, and also a comparison, with statistics, for 1879-80. 2200 w. Eng News—Sept. 20, 1900. No. 36549.

Rolling Mills.

Modern Practice in Rolling Mill Driving (Neue Gesichtspunkte und Erfahrungen im Walzwerks betriebe). H. Ehrhardt. With especial reference to the rolling mill engines exhibited at Paris. 1500 w. Stahl und Eisen—Sept. 1, 1900. No. 36645 D.

Power Consumption of Rolling Mills. A report of tests of the power consumed on various operations, made at a steel works on the Continent. 700 w. Ir Age—Sept. 13, 1900. No. 36377.

Roll-Relieving Device. An illustrated description of a quick and simple roll-relieving mechanism in use at the Lukens Iron & Steel Co.'s works, invented by Chas. L. Huston. 700 w. Ir Trd Rev—Sept. 20, 1900. No. 36784.

Three-High Rolls (Ueber Trio Walzen). Fr. Horn. An examination of the correct dimensions and forms of passes in rolls for three-high rolling mills. 1800 w. Stahl und Eisen—Sept. 1, 1900. No. 36646 D.

Solution Theory.

Contributions to the Solution Theory of Iron and Steel (Beiträge zur Lösungstheorie von Eisen und Stahl). H. Juptner von Jonstorff. A further contribution to the physical chemistry of steel and iron, with numerous examples in support of the solution theory. 2000 w. Stahl und Eisen—Sept. 1, 1900. No. 36647 D.

Steel Castings.

Steel Castings. From a paper by M. Tissot before the International Congress on Mining and Metallurgy, Paris, giving a review of the subject. 1200 w. Ry & Eng Rev—Sept. 22, 1900. No. 36834.

Steels.

Special Steels. L. Babu. From a paper prepared for the Min. & Met. Cong., at Paris. Considers the making, working, hardening and annealing. 2500 w. Col Guard—Aug. 24, 1900. No. 36237 A.

Tilly Foster.

The Tilly Foster Mine. Edward K. Landis. Gives the history of this iron mine and the method of working. 1000 w. Jour Fr Inst—Sept., 1900. No. 36290 D.

Trade Prospects.

Iron and Steel Prospects. An editorial discussing the situation in the British iron and steel trade, as affected by American and German competition, with diagrams. 1800 w. Engng—Sept. 7, 1900. No. 36456 A.

Ural.

The Iron Industry in the Ural (L'Industrie du Fer dans l'Oural). P. Kouindjy. A complete review of the subject, based upon official reports and issued by the Russian Ministry of Finance. 8000 w. Bull Soc d'Encour—July, 1900. No. 36635 G.

MINING.

Excavator.

An Excavating and Loading Machine for Transferring Ore to Railway Cars. A short illustrated description of a machine made by the Jeffery Manufacturing Co. for the Fayal Iron Co., of Minnesota. 250 w. Eng News—Sept. 20, 1900. No. 36570.

Explosives.

Safety Explosives at the Paris Mining Congress (Die auf dem Internationalen Kongress fur Bergbau und Hüttenwesen zu Paris Gehaltenen Vorträge über Sicherheitssprengstoffe). H. Heise. A report of the discussions at Paris on safety mining explosives. 3000 w. Glückauf—Aug. 25, 1900. No. 36669 B.

Lamps.

Report on the Investigation of Mining Lamps (Bericht über die auf Berggewerkschaftlichen Versuchsstation bisher Ausgeführten Lampenuntersuchungen). H. Fähndrich. A report of tests of various mining lamps with respect to their capacity for igniting mine gases. 5000 w. Glückauf—Sept. 15, 1900. No. 36671 B.

Miners.

The Miner in Yorkshire and South Africa: His Income and Expenditure Compared. Tabulated statement and interesting comparison. 1300 w. Col Guard—Aug. 24, 1900. No. 36235 A.

Mining Law.

Some Recent Cases on the Law of Support. Some cases on damage caused by subsidence as recently decided in English courts. 2000 w. Col Guard—Aug. 31, 1900. No. 36357 A.

Safety.

Personal Safety in Electric Mining Plants (Die Personliche Sicherheit bei Elektrischen Anlagen in Bergwerken). W. Philippi. With details as to the isolation of conductors, protection of generators and motors, and the ignition of firedamp. 4000 w. Glückauf—Aug. 18, 1900. No. 36668 B.

Shaft Sinking.

The Simultaneous Sinking and Walling of Shafts (Fonçage et muraillement Simultanés d'un Puits). Describing the method employed by M. Matheron at the Bouble mines. The masonry was built in sections as the shaft was sunk. 1200 w. Génie Civil—Aug. 18, 1900. No. 36630 D.

Tasmania.

Tasmanian Mining Affairs. E. Mulcahy. A ministerial statement of policy and progress, with editorial comment. 4200 w. Aust Min Stand—Aug. 2, 1900. No. 36383 B.

Temperature.

The Temperature of the Strata of the Ruhr Coal Basin (Ueber die Temperatur der Gebirgsschichten des Ruhrsteinkohlenbeckens). H. Kette. With diagrams and tables based on numerous observations, showing the relation of temperature and depth. 4000 w. 2 plates. Glückauf—Sept. 1, 1900. No. 36670 B.

Ventilation.

Loss of Load Due to the Motion of Air in Mine Shafts. From a communication by M. Paul Petit to the International Mining and Metallurgical Congress at Paris on calculating the loss of load in order to arrive at the total depression required for ventilating the face of a heading. 3000 w. Col Guard—Sept. 14, 1900. No. 36762 A.

Substitution of Convergent-Divergent Adjutages for Wickets in Mine Ventilation. Paul Petit. From a paper prepared for the Min. & Met. Cong., Paris. An illustrated account of experimental investigations, with conclusions. 3000 w. Col Guard—Aug. 24, 1900. No. 36236 A.

MISCELLANY.

Abrasives.

The Production of Abrasives. From the annual report of the United States Geological Survey, compiled by E. W. Parker, giving production of mineral abrasives and also carborundum and crushed steel. 1500 w. Ir Age—Sept. 20, 1900. No. 36521.

Aluminum.

Aluminum at a Moderate Price. M. Heroult. Abstract of a paper before the International Congress of Mining and Metallurgy at Paris, giving a general account of the Heroult, or Hall, electrolytic process, with a brief review of the advance made in methods of producing aluminum. 1200 w. Eng & Min Jour—Sept. 15, 1900. No. 36408.

Assaying.

The Assay Practice of the West Compared with That of the School of Mines. Charles Fulton. An account of methods used in both places. 1200 w. School of Mines Quar—July, 1900. No. 36542 D.

Brass.

The Properties of Brass Made from Copper Containing Sub-Oxide, with Observations of the Effect of Oxygen on Copper. Edwin S. Sperry. An account of experimental investigations, concluding that unless the amount of oxygen is large it cannot be called an injurious impurity. 4000 w. Trans Am Inst of Min Engs—Aug., 1900. No. 36337 D.

Diamonds.

The Diamond Industry of the Cape. (L'Industrie Diamantifere au Cap). F. Schiff. A discussion of the geology and working details of the diamond mines of the Cape of Good Hope. 2500 w. Génie Civil—Aug. 18, 1900. No. 36629 D.

Fuller's Earth.

The Occurrence of Fuller's Earth in the United States. David T. Day. Considers the characteristics and the development of the industry in the United States. 2200 w. Jour Fr Inst—Sept., 1900. No. 36289 D.

Lead.

Blast Furnace Slags in Lead Smelting. C. C. Longridge, in London *Mining Journal*. How to secure good separation, giving the composition of several useful slags, and discussing the effect of various constituents. 1500 w. B. C. Min Rec—Sept., 1900. No. 36351 B.

Manganese.

Manganese Mining. C. H. Vannier. Discusses the valuable properties of manganese, and gives an illustrated account of the Crimora mines in Virginia. 1100 w. Mod Mach—Sept., 1900. No. 36255.

The Manganese Ore Trade of Russia. Solon J. Vlasto. An account of the manganese ore industry in the Caucasus. 1400 w. Eng & Min Jour—Sept. 22, 1900. No. 36753.

Mica.

Mica Mining in India and the United States. An illustrated account of mica mining in India. 1100 w. Mining & Scien Press—Sept. 8, 1900. No. 36447.

Petroleum.

Applications of Petroleum in Metallurgy, and in Glass Manufacture (Applications du Pétrole à la Metallurgie et à l'Industrie du Verre). G. de Krivochapkine. Showing especially the Nobel grate as applied to reverberatory furnaces. 1500 w. Génie Civil—Aug. 25, 1900. No. 36632 D.

Roumanian Petroleum (Rumänisches Erdöl). J. Tanasescu. An account of the physical and chemical properties of Roumanian petroleum. 2000 w. Oesterr Zeitschr f Berg u Hüttenwesen—Aug. 18, 1900. No. 36672 B.

Petroleum Industry of Canada. John D. Noble. Paper before the International

Petroleum Congress, Paris, on the oil wells in the Petrolia district, and methods of boring, storage and drilling. 2400 w. Am Gas Lgt Jour—Sept. 24, 1900. No. 36789.

Platinum.

Notes on the Occurrence of Platinum in North America. David T. Day. Gives results of careful examination and inquiry, the conditions of occurrence, etc. 1900 w. Trans Am Inst of Min Engs—Aug., 1900. No. 36335 D.

Potassium.

Mining Potassium Salts in Germany. E. Mackey-Heriot. A short description of the deposits, geology, etc. 1000 w. Eng & Min Jour—Sept. 1, 1900. No. 36211.

Quarrying.

The Helicoidal Wire System of Quarrying. N. Pellati. Abstract of a paper before the International Congress of Mining and Metallurgy in Paris, describing a method of making cuts in marble and other stone with a wire-cord formed of three hard steel wires twisted together with a very slow pitch. 1100 w. Eng & Min Jour—Sept. 15, 1900. No. 36406.

Russia.

Foreign Capital in Russian Industrial Undertakings. An article from the *Financial Chronicle*, reviewing the part taken by foreign investors in the development of Russia. 1100 w. Ir Age—Sept. 27, 1900. No. 36757.

Mining and Metallurgy in South Russia (Le 24 Congrès de l'Industrie Minérale du Sud de la Russie). An account of the proceedings of a meeting of those engaged in mining and metallurgy in South Russia, with statements about the coal, iron and other industries, and lines of communication. 2500 w. Moniteur Industriel—May 26, 1900. No. 36566 E.

Shale Oil.

The Oil-Bearing Shales of the Coast of Brazil. John C. Branner. Describes the material and the width of the belt at various places, the exposures, etc. Ill. 3800 w. Trans Am Inst of Min Engs—Aug., 1900. No. 36340 D.

Smelter.

The Smelting Corporation's Works at Ellesmere Park, England. J. L. F. Vogel. An account, with illustrations, of the Fry process of treating zinc-lead sulphides. 2500 w. Eng & Min Jour—Sept. 29, 1900. No. 36856.

Spain.

The Mining Industry in Spain (De l'Industrie des Mines en Espagne). A serial article giving a general review of mines and mining in Spain. Serial. 1st part. 1000 w. Moniteur Industriel—June 23, 1900. No. 36836 E.

Uranium.

Uranium and Its Ores. J. Ohly. Describes the ores and some of the uses. 1600 w. Min & Sci Pr—Aug. 25, 1900. No. 36194.

Zinc.

See Electrical Engineering, Electro-Chemistry.

RAILWAY AFFAIRS

CONDUCTING TRANSPORTATION.

Accidents.

A Year's Railway Accidents. Extracts from Mr. Hopwood's report to the British Board of Trade on railway accidents during 1899. 1700 w. Transport—Sept. 14, 1900. No. 36830 A.

Fast Trains.

Long and Fast Railroad Runs. Tables from the London *Engineer* of British, American and French fast trains, running 100 miles and upwards. 900 w. R R Gaz—Sept. 28, 1900. No. 36801.

Long-Distance Railway Runs. A comparison of long-distance fast trains in England, America and France, with tables. 1000 w. Engr, Lond—Sept. 7, 1900. No. 36463 A.

The Fastest Trains of the World in 1899. Four tables of American, French and British fast trains, reprinted from the London *Times* of Aug. 17, 1900, with comment. 1800 w. R R Gaz—Sept. 21, 1900. No. 36579.

M. C. B. Rules.

Revision of the M. C. B. Rules of Interchange. Changes made at the annual convention of the M. C. B. Assn., to take effect Sept. 1, 1900. 900 w. R R Car Jour—Sept., 1900. No. 36378.

Spain.

Railways in Spain. A general account of Spanish railways. 1800 w. Sci Am Sup—Sept. 22, 1900. No. 36586.

FINANCIAL.

French Railways.

Earnings and Operating Expenses of the French Railways for 1899 (Chemins de Fer Français Recettes et Dépenses d'Exploitation en 1899). Abstracts of company reports, with table of gross earnings and operating expenses. 1000 w. Moniteur Industriel—June 2, 1900. No. 36567 E.

Purchase.

The Government Purchase of the Great Indian Peninsula Railway. Information concerning the causes of delay in the acquisition, and related matter. 1500 w. Transport—Aug. 31, 1900. No. 36330 A.

MOTIVE POWER AND EQUIPMENT.

Acetylene.

See Gas Engineering.

Boiler Tubes.

Long Tubes for Locomotive Boilers. Geo. L. Fowler. Letter making a brief review of the state of the art, and giving a short summary of available data on the subject. 1500 w. R R Gaz—Sept. 21, 1900. No. 36573.

Brakes.

Inertia Brake Attachment. An illustrated description of an apparatus designed by H. H. Westinghouse, in which the inertia of a weight acts to increase the braking pressure. 600 w. Ry & Eng Rev—Sept. 22, 1900. No. 36835.

The Electrical Control of Air Brakes. (Ueber eine Elektrische Steuerung von Luftdruckbremsen). H. Wagner. Describing an electrical attachment for use with the Westinghouse brake, enabling greater promptness in braking to be made. 3500 w. Glaser's Annalen—Sept. 15, 1900. No. 36658 D.

Brake Shoes.

Mr. S. P. Bush on Brake Shoes. Abstract of remarks before the Western Railway Club, by the chairman of the M. C. B. Brake Shoe Committee, on the development of high power brake shoes. 500 w. R R Gaz—Sept. 28, 1900. No. 36802.

The Effect of Temperature on the Friction of Brake Shoes. From a paper by Prof. R. A. Smart before the Western Railway Club, giving the results of experiments, with curves. 1700 w. R R Gaz—Sept. 28, 1900. No. 36804.

The Friction of Brake Shoes Under Various Conditions of Pressure, Speed and Temperature. R. A. Smart. Abstract of a paper before the Western Railway Club, giving the results of tests made at Purdue University. 1800 w. Eng News—Sept. 27, 1900. No. 36851.

Cars.

An English Private Car. Illustrated description of a private car for the Duke of Sutherland, L. & N. W. R. R., England. 400 w. R R Car Jour—Sept., 1900. No. 36381.

An Epoch in Railroad Transportation. Henrik V. Van Z. Loss. Extracts from a paper for the Paris International Railroad Congress, calling attention to the advantages of pressed steel cars. 2500 w. R R Gaz—Sept. 28, 1900. No. 36805.

80,000-Pound Side-Dump Cars. Drawings and description of fifty cars recently built for the transporting of coal, ore and ballast on the C. L. and W. Ry. 700 w. Am Eng & R R Jour—Sept., 1900. No. 36281 C.

The Pressed Steel Car. From a paper by Sumner B. Ely before the Engineers' Society of Western Pennsylvania, giving an illustrated account of pressed steel and pressed steel cars. 2000 w. Ir Age—Sept. 27, 1900. No. 36760.

Draw Gear.

Some Observations on Draw Gear. George S. Hodgins. Calling attention to defects, and changes needed. 1400 w. R R Car Jour—Sept., 1900. No. 36379.

Elevator.

Automatic Ash Elevator. Illustrates and describes an arrangement for handling locomotive ashes. 700 w. Am Engr & R R Jour—Sept., 1900. No. 36284 C.

Engineers' Association.

The Traveling Engineers' Association. A notice of the Cleveland meeting, with abstracts of the reports of various technical committees. 4000 w. R R Gaz—Sept. 21, 1900. No. 36574.

Exposition.

At the Paris Exposition. The United States Transportation exhibits at Vincennes illustrated and described. 2000 w. Ry Age—Sept. 14, 1900. No. 36477.

Locomotive Exhibits at Vincennes. Charles Rous-Marten. A general review of the exhibits. 2200 w. Engr, Lond—Sept. 14, 1900. No. 36701 A.

Paris Exposition. American Cars and Car Supplies in the Transportation Building. An illustrated account of American exhibits at Paris. 1800 w. Ry Age—Sept. 21, 1900. No. 36829.

The Collective Exhibit of the North German Car Building Association (Kollektivausstellung der Norddeutschen Wagenbau-Vereinigung). A fully illustrated description of the various railway carriages exhibited at Paris. Two articles. 6000 w. 5 plates. Glaser's Annalen—Sept. 1, 15, 1900. No. 36657 each D.

Feed-Water Purification.

Purification of Feed-Water. J. A. F. Aspinwall. Abstract from a report on the "Purification of Feed-water of Locomotives and the Use of Disincrustants," prepared for the International Railway Congress. 1800 w. Ir & Coal Trds Rev—Sept. 7, 1900. No. 36483 A.

Journal Box.

The Proposed 5½ by 10 M. C. B. Journal Box. F. M. Whyte. A criticism, with replies. Ill. 1100 w. Am Engr & R R Jour—Sept., 1900. No. 36283 C.

Lights.

Back Lights. W. H. Lane. Read be-

fore the Ry. Sig. Club. Discusses the dangers due to present practice in the use of signal lights, and the means of overcoming them. 1200 w. Ry & Engng Rev —Sept. 8, 1900. No. 36354.

Locomotive Painting.

Painting of Pennsylvania Railroad Locomotives. C. H. Caruthers. Describes the practice of this road. 1000 w. R R Gaz—Aug. 31, 1900. No. 36186.

Locomotives.

Compound Express Locomotive (Locomotive Compound Express). F. Barbier. An illustrated account of the Krauss locomotive exhibited at Paris, with auxiliary driving mechanism on the forward truck. 2000 w. 1 plate. Génie Civil—Aug. 11, 1900. No. 36625 D.

Compound High Speed Locomotives of the Northern Railway of France (Locomotives Compound à Grand Vitesse des Chemins de Fer du Nord Française). F. Barbier. Illustrating and describing in detail the powerful four-cylinder compound express locomotives of M. der Bousquet for the Northern Railway of France. 2000 w. 1 plate. Génie Civil—Aug. 25, 1900. No. 36631 D.

Decapod Compound Locomotive for the Minneapolis, St. Paul & Sault Ste. Marie Ry. An illustrated description of a locomotive with five pairs of driving wheels, guaranteed to haul a train load of 2000 tons, built by Baldwin Locomotive Works. 1000 w. Eng News—Sept. 20, 1900. No. 36545.

Details of Class "D" Passenger Locomotives of the Chicago & Northwestern. A well illustrated description of details. R R Gaz—Sept. 21, 1900. No. 36575.

Early Locomotive Building in Massachusetts. Herman L. Morse. Review of work of several firms. 2500 w. Loc Engng—Sept., 1900. No. 36190 C.

Fast Heavy Passenger Service on the Central Railroad of New Jersey. An account of a trip between Asbury Park and Jersey City, with illustration of engine. 900 w. Loc Engng—Sept., 1900. No. 36191 C.

Four-Cylinder Compound Locomotives in France. Abstract of a paper by Edouard Sauvage, before the Institute of Mechanical Engineers, on "Recent Locomotive Practice in France," giving descriptions of different types of four-cylinder compound locomotives, with tables and illustrations. 3600 w. R R Gaz—Sept. 28, 1900. No. 36799.

French Four-Cylinder Compounds. An editorial discussion of the compound type of locomotive. 1800 w. R R Gaz—Sept. 28, 1900. No. 36806.

German Locomotives at the Paris Exhibition. Begins an illustrated description of the exhibit of the Sächsische Maschinenfabrik, of Chemnitz. 250 w. Engng—Aug. 24, 1900. Serial. 1st part. No. 36239 A.

German Locomotives at the Paris Exhibition. Compound Locomotive for the Royal Bavarian Railways, Constructed by Messrs. Maffei & Co., Munich. A very well illustrated description of an articulated locomotive on the Mallet system. 1 plate. 800 w. Engng—Sept. 7, 1900. No. 36455 A.

Heavy Consolidation Locomotive for the Illinois Central Railroad. A well illustrated description of a 218,000-pound locomotive for hauling 3,000-ton trains, built by Rogers, at Paterson, N. J. 900 w. Engng—Sept. 14, 1900. No. 36593 A.

Italian Locomotive at the Paris Exhibition. An illustrated description of a six-coupled compound locomotive of the Mediterranean Railway Co. 700 w. Engng—Sept. 14, 1900. No. 36597 A.

New "Highland" Locomotive. Illustration and brief description of new ten-wheel express engine for Highland Ry., of Scotland; one of the "Castle" class. 300 w. Loc Engng—Sept., 1900. No. 36189 C.

Richmond Consolidation Locomotive. Rio Grande Western Ry. Illustrates and describes heavy locomotives, eight of which have been received and are in service, giving satisfactory results. 1200 w. Ry & Engng Rev—Sept. 1, 1900. No. 36286.

Ten-Wheeled Express Locomotive for the Highland Railway. An illustrated description of a powerful type of passenger locomotive, built in Glasgow. 500 w. Transport—Sept. 7, 1900. No. 36429 A.

Ten-Wheel Passenger Engine for Chicago, Rock Island & Pacific. Illustration and general dimensions. 200 w. Loc Engng—Sept., 1900. No. 36192 C.

The Mallet Articulated Compound Locomotive. Abstract of a paper by M. A. Mallet in the *Revue Generale des Chemins de fer*, describing the progress in the use of this four-cylinder locomotive, all of whose wheels are drivers, with illustration. 900 w. R R Gaz—Sept. 14, 1900. No. 36424.

The Paris Exhibition. Borsig Locomotive, with Superheater. A well illustrated description of a powerful locomotive fitted with a superheater constructed under the Wm. Schmidt patent. 1 plate. 1500 w. Engr, Lond—Sept. 7, 1900. No. 36466 A.

Wide Firebox 10-Wheel Passenger Locomotive. Drawings and description of engines built for the D. L. & W. R. R., which are the heaviest passenger locomotives ever built. 900 w. Am Engr & R R Jour—Sept., 1900. No. 36282 C.

Rolling Stock.

New Rolling Stock for Express Trains of the Northern Railway of France (Le Nouveau Materiél à Bogies pour Trains

Rapides du Chemin de Fer du Nord). M. Defauconpret. A very detailed account of the new corridor bogie railway carriages of the Northern Railway of France. 18000 w. 5 plates. Rev Gen des Chemins de Fer—July, 1900. No. 36644 H.

Ton-Mileage.

Ton-Mileage for Motive Power Statistics. C. H. Quereau. Discussing whether the tonnage of the engine should be included in the ton-mileage. 3000 w. R R Gaz—Aug. 31, 1900. No. 36182.

NEW PROJECTS.

Austria.

The Solution of the Tauernbahn Route (Zur Lösung der Tauernbahnfrage). A. Waldvogel. A discussion of the railway proposed to connect the Tyrol with Trieste, with maps and profiles of the various routes. Two articles. 10000 w. Zeitschr d Oesterr Ing u Arch Ver—Aug. 17, 1900. No. 36621 each B.

China.

Railway Construction in French Indo-China. A review of various French projects in Indo-China and Southern China. 1100 w. Engng—Sept. 14, 1900. No. 36594 A.

The Building of the German Railway in Shan Tung (Der Bau der Deutschen Eisenbahn in Shantung). A general description from the *Zeitung der Verein Deutschen Eisenbahnverwaltungen* of the line of the railway which has been started inland from Kiauchou, China. 1000 w. Zeitschr f Klein u Strassenbahnen—Aug. 1, 1900. No. 36552 C.

Madagascar.

Ways of Communication and Means of Transport on Madagascar (Madagascar. Voies de Communications et Mayens de Transport). J. J. Marie. A report of a committee of the Société des Ingénieurs Civils de France, with critical comments by the *Moniteur Industriel*. Serial. 2 parts. 10000 w. Moniteur Industriel—June 9, 16, 1900. No. 36568 each E.

New Railroads.

Six Months of Railroad Building in 1900. Particulars in detail, by states and territories, of railroads building and sections completed. 2000 w. R R Gaz—Aug. 31, 1900. No. 36185.

PERMANENT WAY AND BUILDINGS.

Ballast.

On the Structure of Cementing Gravel. Geo. R. Wieland. Discusses the manner in which material such as cementing gravel, used as ballast, forms rocks. 900 w. Ry & Engng Rev—Sept. 15, 1900. No. 36428.

Curves.

Railway Transition Curves. F. K. Vial. An analysis of the fundamental principles, simple demonstrations, and tables of deflections and co-ordinates. 6500 w. Eng News—Sept. 20, 1900. No. 36571.

Derailments.

Derailments. J. H. Wallace. A paper presented before the Pacific Coast Railway Club, discussing the causes of derailments on curves. 1500 w. Ry & Engng Rev—Sept. 15, 1900. No. 36427.

Ditching Machine.

Ditching Machine on the Chicago Great Western. An illustrated description of a ditcher car which has done good service. 1000 w. Ry & Engng Rev—Sept. 15, 1900. No. 36425.

Eastern Association.

Eastern Maintenance of Way Association Meeting. Abstracts of papers and reports of committees at the meeting at Saratoga. 1300 w. R R Gaz—Sept. 28, 1900. No. 36800.

Education.

Education of Railroad Men as Subordinates for the Maintenance of Way Service. Walter G. Berg. Abstract of paper before the Eastern Maintenance of Way Association, advocating the establishment of railroad trade schools at important centers. 1400 w. Eng News—Sept. 20, 1900. No. 36548.

Education of Railroad Men for Maintenance of Way. Walter G. Berg. Extracts from a paper before the Eastern Maintenance of Way Association, advocating the establishment of railroad trade schools and presenting an outline programme for such a school. 2500 w. R R Gaz—Sept. 21, 1900. No. 36576.

Galveston.

The Great Texas Hurricane. The effect of the storm upon the railways and shipping. The great dock enterprise of the Southern Pacific R. R. Co., which was wrecked. Illustrated. 1600 w. Ry Age—Sept. 14, 1900. No. 36478.

Japan.

Construction on the Kyoto Ry., Japan. Willard C. Tyler. A short illustrated description, showing construction of wooden false work lashed together with grass rope. 400 w. Ry & Engng Rev—Sept. 15, 1900. No. 36426.

Manchuria.

Russian Railway Construction in Manchuria (Die Russischen Eisenbahnbauten in der Mandschurei). F. Theiss. With map and views of construction work at various points along the line. 2500 w. Oesterr Monatschr f d Oeff Baudienst—Sept., 1900. No. 36650 D.

Paris.

The Works of the Western Orleans and

Metropolitan Railways in Paris (Die Bauten der Französischen Westbahn der Orleans-bahn, und der Stadtbahn in Paris). H. Koestler. A description of the improved terminal facilities recently constructed in Paris, and of the new underground road, with map. 3500 w. 1 plate. Zeitschr d Oesterr Ing u Arch Ver—Aug. 31, 1900. No. 36622 B.

Rails.

Rail Making Problems. Compares old and modern practice, and discusses many points of interest. 2500 w. Ir & Coal Trds Rev—Aug. 24, 1900. No. 36242 A.

Roundhouse.

A Remarkable Roundhouse—Chicago & Northwestern Railway. An illustrated description of a well equipped round house at Clinton, Ia. 900 w. Ry Master Mech—Sept., 1900. No. 36493.

Signals.

Automatic Block Signal Failures Due to Lightning. H. D. Miles. Read before the Ry. Sig. Club. A brief account of steps taken by the Michigan Central R. R. to overcome difficulties due to lightning. 1700 w. Ry & Engng Rev—Sept. 8, 1900. No. 36353.

New Interlocking Electric Switch and Signal System. J. R. Cravath. A well illustrated description of the Taylor system, which is entirely operated by electricity. 1600 w. Elec Wld & Engr—Sept. 15, 1900. No. 36397.

Pneumatic Signalling Plant at the Paris Exhibition. An illustrated description of the system and the exhibit of the International Pneumatic Railway Signalling Co., of Rochester, N. Y. 1500 w. Engng—Sept. 14, 1900. No. 36592 A.

Signals on the State Railways of Belgium (Les Signaux des Chemins de Fer de l'Etat Belge). M. Lavigne. Remarks on an accident, with an account of the signal system on Belgian railways and some French ones. 2000 w. Moniteur Industriel—May 19, 1900. No. 36565 E.

The Taylor Electric Switch and Signal Apparatus. A well illustrated account of this system, which is entirely electric. 2000 w. R R Gaz—Sept. 28, 1900. No. 36803.

Track Diagrams.

The Condition of Track on the New York Central. P. H. Dudley's autographic records of the condition of the track of the New York Central for 1898 and 1899. 1 plate. 600 w. R R Gaz—Sept. 14, 1900. No. 36423.

Tunnels.

The Ventilation of Long Tunnels (Die Lüftung Langer Tunnels). A. Birk. An investigation of the use of fan ventilation for tunnels, with especial reference to the application of the Saccardo system at the St. Gothard tunnel. 4500 w. 1 plate. Oesterr Monatschr f d Oeffent Baudienst—Sept., 1900. No. 36661 D.

TRAFFIC.

Development.

The Development of Nations by Railways (Länder, Völker, und Eisenbahnen). H. Von Mühlenfels. A study of the influence of railways upon national development, a paper presented before the Railway Society at Berlin. Two articles. 6000 w. Glaser's Annalen—Aug. 15, Sept. 1, 1900. No. 36653 each D.

The Railways of the World (Die Eisenbahnen der Erde). Tabulated statistics of the development of the railways of the world from the close of 1894 to the end of 1898, in relation to population. 2000 w. Stahl und Eisen—Sept. 1, 1900. No. 36650 D.

Pooling.

The Pooling of Railway Freight Cars. J. R. Cavanagh, in the *Journal of Political Economy*. A discussion of the loss to railroads by the present system, and suggesting a plan that would greatly increase the revenue. 2200 w. R R Car Jour—Sept., 1900. No. 36380.

Switzerland.

Statistics of the Swiss Railways (Aus der Schweizerischen Eisenbahn-statistik). Tabulated data brought down to the close of 1898, with discussion. 2000 w. Schweizerische Bauzeitung—Aug. 11, 1900. No. 36664 B.

Trans-Siberian.

The Trans-Siberian Railroad. Report from Consul-General W. R. Holloway, St. Petersburg, containing an extract from the *Novoe Vremia*, giving fares and train service. 500 w. U. S. Consular Reports—Sept. 19, 1900. No. 36543.

STREET AND ELECTRIC TRAMWAYS

Berlin.

Electric Driving on the Berlin Municipal Railway (Der Elektrische Betrieb auf der Berliner Stadt-und Ring Bahn). A symposium of contributions from official inspectors and engineers in Berlin concerning the working of the road by electricity. 10000 w. Glaser's Annalen—Aug. 15, 1900. No. 36655 D.

Brazil.

The Sao Paulo Tramway, Light and Power Company. Illustrates and describes the plant of an important city of Southern Brazil. 3000 w. St Ry Jour—Sept. 1, 1900. No. 36278 D.

Car Equipments.

Deficiencies in Car Equipments. R. H.

Tweedy. A criticism of American practice from an English point of view. 1500 w. Elec Rev, Lond—Aug. 24, 1900. No. 36232 A.

Centrifugal Railway.

Coney Island's Centrifugal Railway. An illustrated description of railway in which a car, carrying passengers, runs around the inner circumference of a vertical circle. 400 w. Sci Am—Sept. 22, 1900. No. 36582.

Columbus, O.

Operating Methods of the Columbus Railway Company. Describes the methods and gives information of interest. 3000 w. St Ry Jour—Sept. 1, 1900. No. 36272 D.

Consolidation.

Street Railway Consolidation. Editorial on the advantages of consolidation in economic conditions. 2000 w. St Ry Jour—Sept. 1, 1900. No. 36277 D.

Contact System.

A Simple Closed-Conduit Traction System. An illustrated description of a simple device for making contact between a feeder and sectional conductor as the car passes over the latter. 600 w. Elec Rev, N. Y.—Sept. 19, 1900. No. 36732.

The Dolter Surface Contact System for Tramways (Contact Superficial pour Tramways, Système Dolter). A. Bainville. Detailed description of a system similar to the Diatto, now in operation in Paris. 1800 w. Electricien—Aug. 25, 1900. No. 36687 B.

Conversion.

Preparing to Operate the Broadway Cable Road by Electricity. An illustrated account of rapid and extensive alterations of the track equipment of the Broadway line, without interrupting traffic. 500 w. Elec Rev, N. Y.—Sept. 19, 1900. No. 36730.

Convertible Car.

A Large Convertible Car. An illustrated description of a car seating forty-six persons, built by the J. G. Brill Co., for the New Castle (Pa.) Traction Co., open in summer, closed in winter. 1000 w. St Ry Rev—Sept. 15, 1900. No. 36515 C.

Electric Air-Brake.

A New Electric Air-Brake System. An illustrated description of a system of electrically controlled air-brakes, designed especially for electric cars. 1300 w. Elec Rev, N. Y.—Sept. 19, 1900. No. 36734.

Extension.

Extension of the Plant of the Worcester Consolidated Street Railway. The road is so advantageously placed that it practically controls the largest mileage in New England. Describes the enlargement of the station and unique features to be introduced. 3500 w. St Ry Jour—Sept. 1, 1900. No. 36276 D.

Funicular.

The Funicular Railway of Montmartre at Paris (Le Funiculaire de Montmartre à Paris). J. Laverchère. An illustrated account of the inclined cable railway up Montmartre, in Paris. 2000 w. Génie Civil—Aug. 11, 1900. No. 36627 D.

Interurban.

A Forty-Mile Interurban Electric Railway. W. N. Zurfluh. Illustrated description of the power station and equipment of the Dayton, Springfield & Urbana (Ohio) Railway. 1500 w. Am Elect'n—Sept., 1900. No. 36268.

Locomotive.

Electric Locomotive for Main Railway Lines, Built by the Allgemeine Elektricitäts-Gesellschaft (Elektrische Vollbahn-Lokomotive der A. E. G. auf der Pariser Weltausstellung). An illustrated description of a locomotive which can haul a 300-ton train at the rate of 30 kilometers an hour. 1800 w. Zeitschr f Klein-u Strassenbahnen—Aug. 1, 1900. No. 36551 C.

Main Railways.

Electric Traction on Main Railways. N. H. Heft. A portion of the report made to the International Tramway Congress at Paris in 1900, giving experience on the New York, New Haven & Hartford R. R. 6000 w. St Ry Rev—Sept. 15, 1900. No. 36518 C.

Monorail.

Manchester & Liverpool Railway: Brakes and Signals. F. J. Behr. A paper before the British Association, discussing braking and signalling on the proposed high-speed monorail line. 1400 w. Elec Engr, Lond—Sept. 14, 1900. No. 36744 A.

The Manchester and Liverpool Express Railway. Sir W. H. Preece. Paper before the British Association, giving a brief description of a proposed monorail line, with single-car trains having a speed of 110 miles an hour. 700 w. Elec Rev, Lond—Sept. 14, 1900. No. 36743 A.

New Jersey.

Important Work in Northern New Jersey. Illustrates and describes important extensions to the lines of the New Jersey & Hudson River Railway & Ferry Co., and of their equipment. 1500 w. St Ry Jour—Sept. 1, 1900. No. 36279 D.

Niagara Gorge.

The First Five Years' Experience in Maintaining the Niagara Gorge Railroad. George A. Ricker. An illustrated account of the construction of the road, and features of interest. 3000 w. St Ry Jour—Sept. 1, 1900. No. 36274 D.

Paris.

Street and Local Railways at the Paris Exposition (Die Strassen-und Kleinbahnen auf der Pariser Weltausstellung). Statistics of tramways in Paris, with an illustrated account of the new underground road. 1600 w. Zeitschr f Klein-u Strassenbahnen—Aug. 1, 1900. No. 36-550 C.

The Metropolitan Railway of Paris. Illustrated description of this road, its construction, equipment and operation. 5000 w. St Ry Jour—Sept. 1, 1900. No. 36-273 D.

The Paris Metropolitan Railway (Le Métropolitain de Paris). A review of the probable traffic and finances of this new underground road. 2000 w. Moniteur Industriel—Aug. 4, 1900. No. 36-841 E.

The Metropolitan Railway Company, of Paris (Compagnie du Chemin de Fer Métropolitain de Paris). The report of the administrative council, at the general meeting, on the road and its finances. 3000 w. Moniteur Industriel—July 28, 1900. No. 36838 E.

Pekin.

The Pekin Electric Tramway and Light and Power Station (Die Elektrische Bahn Pekin-Ma-Chia-pu und das Licht-und Kraftwerk Pekin). A. Fischer. With plan of the road and views of the power house. 2000 w. Zeitschr d Ver Deutscher Ing—Sept. 1, 1900. No. 36608 D.

Polyphase Traction.

Polyphase Electric Traction. Prof. C. A. Carus-Wilson. Abstract of a paper before the Institution of Mechanical Engineers, giving an illustrated account of the Burgdorf-Thun railway, in Switzerland. 7000 w. St Ry Rev—Sept. 15, 1900. No. 36514 C.

Portland.

The Street Railways of Portland, Me., and Vicinity. C. B. Fairchild. An illustrated general description of the system of the Portland Railroad Co. and the suburban line of the Portland & Yarmouth Electric Railway Co. 9000 w. St Ry Rev—Sept. 15, 1900. No. 36513 C.

Pressure.

What Pressure Is Dangerous on Electric Railways with Overhead Trolley Wires. William Rung. Translated from the Danish *Civilengeneer*. Gives results of experimental investigations, showing that all pressures between 100 and 1,000 volts must be regarded as equally dangerous, and as the higher pressures lead to greater economy there is no reason for not using them. 1700 w. Nature—Aug. 23, 1900. No. 36226 A.

Rails.

Recent Tramway Construction, with Special Reference to the Demerbe System. Wm. Dawson. Paper before the British Association, giving an illustrated description of the Demerbe trough-type rail and data concerning its satisfactory performance in Bradford. 2400 w. Elec Engr, Lond—Sept. 14, 1900. No. 36741 A.

The Wear of Rails and the Value of Welded Joints (Schienenverschleiss und die Oekonomische Bedentung des Verschweissten Schienenstosses bei Strassenbahnen). K. Beyer. Discussing the wear of tramway rails, with especial reference to the impact on rail-ends at joints. 2000 w. Schweizerische Bauzeitung—Aug. 18, 1900. No. 36665 B.

Seneca Lake.

Elmira & Seneca Lake Ry. An illustrated description of a road in Chemung and Schuyler Counties, New York. 2200 w. St. Ry Rev—Sept. 15, 1900. No. 36-516 C.

Spliced Cars.

Spliced Cars at Rochester, N. Y. An illustrated account of the method of cutting cars in two and lengthening them 9 feet. St Ry Rev—Sept. 15, 1900. No. 36519 C.

Sunderland.

Sunderland Corporation Electric Tramways. Illustrated description of the commencement of what will ultimately be an extensive system of municipal electric tramways. The line opened is 12.5 miles in length. 2000 w. W. Elect'n, Lond—Aug. 24, 1900. No. 36230 A.

Tri-Phase.

The Tri-Phase Electric Cable Road on Mont Dore, France (Die mit Dreiphasen-Strom Elektrisch Betriebene Seilbahn auf den Mont-Dore in Frankreich). E. A. Ziffer. A paper describing this cable road, said to be the only one in Europe worked by tri-phase currents. 2500 w. Mitt d Ver f d Förd d Local-u Strassenbahnwesens—July, 1900. No. 36554 D.

Wagon Tracks.

Wagon Tracks in Silesia (Strassengleise in Schlesien). H. Pusch. An article from the *Centralblatt für Bauverwaltung*, describing steel tracks for wagons laid down in a Silesian village street. 1000 w. Mitt de Ver f d Förd d Local-u Strassenbahnwesens—July, 1900. No. 36-555 D.

Wichita, Kan.

The Early Wichita Electric Railway, Built in 1887. T. C. Hughes. Brief illustrated description of interesting details of this enterprise. 900 w. St Ry Jour—Sept. 1, 1900. No. 36275 D.

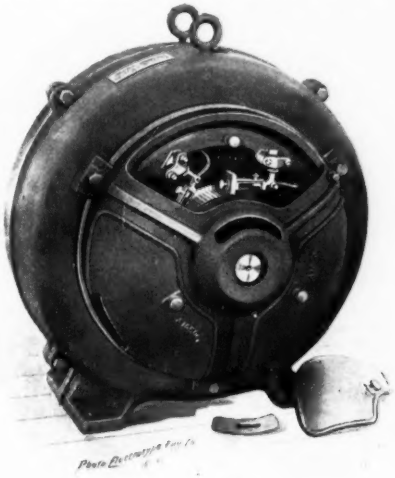
IMPROVED MACHINERY

New Processes and New Appliances

The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

A New Type of Enclosed Motor.

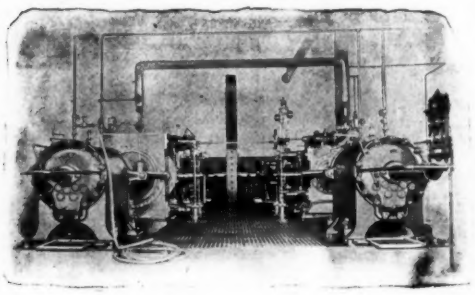
THE accompanying illustration shows a new type of slow speed enclosed motor, designed by Mr. Robert Lundell and manufactured by the Sprague Electric Company. It is electrically identical with the pedestal motors, but instead of being supported by pedestals it has brackets attached to the field frame. It is designed with a view of making a line of motors with the same speed, horse-power, output and characteristics as the medium speed type. It has self-oiling ring bearings and removable covers, and can be used as an open or as an enclosed dust proof motor. It can be attached to the floor, wall or ceiling. The enclosure doors are so designed that when removed the motor is complete and has no knobs or projections that are unsightly. The brushes are mounted on a rocker arm which is adjustable and can be provided with a hand wheel if used as an open type motor. It can also be provided with sliding rails. These motors range in size from ½ to 50 horse power and in speed from 150 to 1,000 revolutions per minute. They are made in all standard voltages, and can be used for direct connection, gear or belt driving.



The Ingersoll-Sargeant Paris Exhibit.

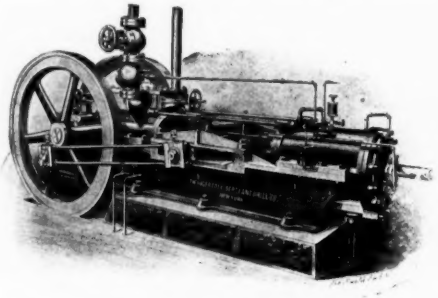
ONE of the most extensive exhibits of the United States is that of the Ingersoll-Sargeant Drill Company, New York, which company has exhibits of its air compressing, mining, tunneling and quarrying machinery in three places. On the Champ de Mars, in the Palace of Machinery and Electricity, it has established its headquarters in the United States Machinery Section. Here one of the company's Class H compressors is in operation, supplying air for all the pneumatic tool companies' exhibits and the tubular dispatch of the Batcheller

Pneumatic Tube Company. This compressor has duplex steam and compound air cylinders. The former are 12 by 12 in.,



and the latter 18 in. diameter for low pressure, 12 in. diameter for high pressure and 12 in. stroke for both. The engine is of the well-known Tangye frame type, mounted on a solid base which contains a special cooler through which the air passes on its way from the low to the high pressure cylinder. In this way its temperature is reduced to about that of running water, and the work required to compress a given volume of air is considerably reduced. In this machine the cylinders are jacketed all around and in the heads, by which arrangement the air is cooled and the working parts kept at a low temperature. Adjustable cut-offs are used for the steam cylinders, with a range of from ¼ to ¾ cut-off, while an automatic regulator, which is attached to the air receiver or reservoir, maintains a constant air pressure, cutting off the steam supply or opening up to a greater or less extent as the air pressure runs or drops below the set pressure. In this case, the compressor regulates to within 1 to 1½ lbs., when set for 100 lbs.

It is, however, at Vincennes, where the company has the main exhibit, that the most interest centers. Occupying a space 41 by 34½ ft., or about 1,400 sq. ft., in a prominent position, it has two compressors and all of its mining and quarrying apparatus in the form of rock drills, coal cutters and channeling apparatus. The largest compressor shown, occupying one side, is a horizontal cross compound Corliss type, with steam cylinders 12 by 22 and a 30-in. stroke. The low-pressure air cylinder is 16¼ by 30 in., and the high-pressure 10¼ by 30 in. Between them is placed a Sergeant vertical intercooler, shown herewith. This device effectually removes the heat resulting from compression in the first cylinder and at the same time acts as a receiver or reservoir from which the high-pressure cylinder draws. The low-pressure cylinder has an exceedingly novel and satisfactory form of inlet and discharge valve devised by Mr. H. S. Sergeant, the engineer of the company. This is a type of mechanical valve which avoids the difficulties inherent with air-compressor valves which have rigid rod connections, and it depends upon compressed air for its operation. In this way a perfect adjustment can be obtained, and cards taken from the cylinder are as regular as those obtained from a well-adjusted Corliss steam cylinder.



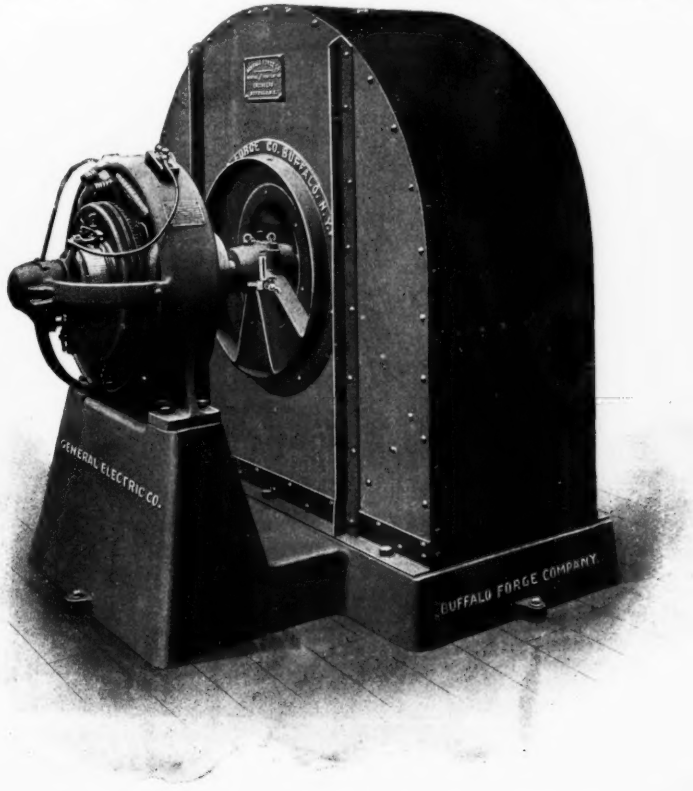
Electric Steel-Plate Fans.

THE electric motor, by reason of its simple rotary motion, is peculiarly fitted for driving, by direct connection, such pieces of apparatus which partake of similar motions. In the case, for instance, of a rotary fan or blower for handling air direct connected to a motor, the uniform resistance to the revolution of the fan is overcome by a uniform torque or twisting force acting on the motor armature. The consequent result is uniformity of speed and power supply.

The accompanying illustration shows one form of such apparatus as manufactured by

the Buffalo Forge Company, of Buffalo, N. Y. The fan is of the Buffalo full housing bottom horizontal discharge type, built as an exhauster, that is, having but one inlet. The fan wheel is overhung, and the single bearing next to the motor is of the Buffalo ring oiling pattern, thereby insuring the positive lubrication so essential under conditions of high speed and continuous running. The absence of a bearing on the inlet side is a very desirable feature in that it facilitates pipe connections when the machine is used as an exhauster. In the case of handling hot gases the desirability of not having them flow in direct contact with a bearing is readily apparent, though for such use water cooling boxes may be provided where so desired. A further advantage of the single inlet is that the in-rushing, dust-laden air currents do not pass through the motor. The Buffalo Forge Company builds these fans both for blowing and exhausting purposes; when used for the latter, the inlet next to the motor is closed by a concave cap fitting closely around the shaft.

The blast wheel is built up of curved steel-plate blades bolted at their centers to the spider arms and at their edges to conical side plates for securing additional rigidity. Wrought iron tee arms cast into heavy hubs form the spiders, of which but one is used in small blast wheels. As to the scroll and sides of the housing, these are of heavy steel-plate, bolted together, rigidly braced with angle irons, and secured to the heavy cast iron base. An upright extension of this base provides a bed for bolting down the motor. This arrangement gives a solid compact unit, and possesses many obvious advantages over the construction which mounts the motor in the housing, in which



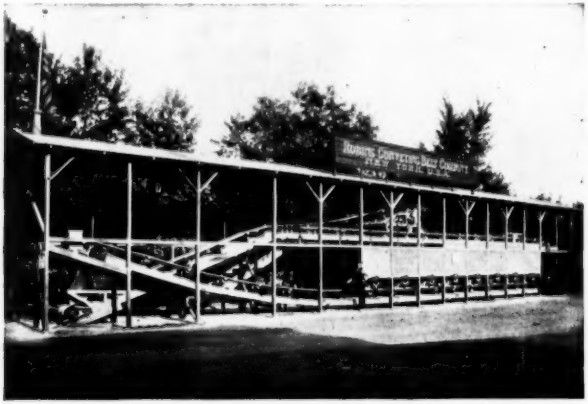
case alignment is more or less quickly destroyed by the play due to the vibrations of high speeds.

The motor operating the fan in this case is a six-pole machine designed especially for such work by the General Electric Company, and embodies all the desirable features gained by long experience in these lines. Built to meet extreme variations of load, the motor nevertheless is practically free from sparking. Hence there is no wear upon the commutator aside from that due to friction, which with carbon brushes is so slight as to be negligible. The armature coils are machine made, separately insulted and tested, and are interchangeable for each size and voltage. The construction is such that currents of air constantly circulate through the core and windings, thus thoroughly cooling them. A desirable feature of the brush-holder is the provision of a flexible connection to the brushes, which allows a free movement of the brush in the holder and thus avoids the resistance due to imperfect contact.

In order to insure a perfect running balance, these machines are set up in the shop, connected to their motors, and carefully brought to balance. This procedure is essential for best results. It may be added, in conclusion, that these fans are widely used in many varying situations. The particular type here illustrated is very popular in central power plants for purposes of ventilation, mechanical draft, and transformer cooling.

Robins Conveying Belt Exhibit.

THE photograph here reproduced shows an exhibit of the Robins Conveying Belt Company, New York, at the Vincennes Machinery Annex of the Paris Exposition, for which the company was awarded a Grand Prix. It consists of a twenty-inch Robins belt conveyor ninety feet long, running level under a series of bins, after clearing which it takes a curved incline, elevating the material to a height of seven feet, at which point it is delivered to a horizontal twenty-inch conveyor, which carries the material in the reverse direction. On this upper line of conveyor a patent tripper operates, distributing the material into the bins, reversing automatically at each end of the bins and requiring no attendance. The capacity of the system is 200 tons per hour



and it is constantly in operation handling broken stone.

The company also makes two other exhibits, one in the Machinery and Electricity Building, consisting of two twenty-inch conveyors thirty-five feet long, and the other in the Mining Building, consisting of a one-quarter size model, including the automatic tripper, of the Vincennes exhibit. These exhibits are also in constant operation. In addition to the machinery, there is a large collection of photographs of Robins belt conveyors, showing installations in all the mining countries of the world. While some of the pictures were of interest to the exposition crowds, it was the conveyors themselves that attracted the attention of all, especially those on which automatically reversing trippers were working. This invention had never been exhibited before in Europe, and the smoothness and regularity of its operation, requiring no attention whatever, excited a great deal of curiosity and interest.

Special Exposition catalogues were attractively gotten up in French and English, with many illustrations, for distribution at each of the exhibits.

American Steel and Wire at Paris.

THE American Steel & Wire Company's exhibit at the Paris Exposition is one of the most complete and interesting of the entire show. The installation is in the department of Mines and Metallurgy, and was not placed with the other exhibits from the United States for lack of space.

On the main floor the exhibit occupies a space 50 x 50 feet. It comprises iron ores and coal from the company's mines in Michigan, Minnesota, Wisconsin and Pennsylvania; limestone, coke, and pig iron. The quality and nature of the pig iron were illustrated by fractures; ingots, blooms, and billets from Bessemer and open-hearth steel mills.

All the above are compactly grouped near the entrance to the exhibit. In the center is an ornamental bronze pagoda with art glass roof, in which pagoda are panels illustrating various manufactured products, such as sections of beams, channels, angles, and bars; sections of shafting, rail splices, and frog filling; horseshoes, spikes, nails, and tacks, barbed wires, bale ties, fine copper wires, music wires, fine spooled wires, all sorts of chains and rivets, coiled, spiral, and flat springs, clock springs, wire ropes, insulated wires and cables, sections of submarine cables, etc.

In the space surrounding the pagoda are samples of sheet steel, with illustrations of quality in the shape of cold bending and stamping tests, large steel boiler heads, many bundles of woven wire fences, and galvanized poultry netting. Piled in pyramids are wire rods, steel, and copper wire in bundles and on reels; copper trolley wires, weatherproof and lead encased cables; copper rail bonds, wire ropes and so on.

The gallery or auxiliary exhibit consists of forty large panels, 6 x 5 feet, on which are artistically grouped products of the various departments, while in glass cases beneath the panels additional samples and test pieces are shown, the entire square being surmounted with fifty large photographic reproductions or bird's-eye views of the various mines, furnaces, steamships, and manufacturing establishments owned and operated by the company.

The American Steel & Wire Company's exhibit won four Grand Prizes, two gold medals, and a collaboratory gold medal each to President Palmer and Chief-Engineer Daniels, of the company.

Industrial Notes.

The American Bridge Company have commenced making very large shipments on account of the steel work of the Subway in New York City. Already about 2,000 tons have been shipped, and the material is now being sent in at the rate of about 100 tons per day. The total contract comprises about 80,000 tons of structural material, and is being manufactured at the Keystone plant of the American Bridge Company.

A contract has just been awarded for the construction of new buildings at Jamaica Plain for the Buff & Buff Mfg. Company, manufacturers of engineering and surveying instruments. The plans call for two-story brick structures, to be planned and constructed after the latest type of mill construction. An independent and isolated stone building is included to accommodate

the precise graduating engines owned by this concern.

The shafts of the United States battleship Wisconsin and the Russian cruiser Variag, both of which recently showed remarkable results on their trial trips, were furnished by the Bethlehem Steel Company. The Wisconsin's shafts were forged from fluid-compressed nickel-steel, and those for the Variag from fluid-compressed carbon steel, all being shaped under the hydraulic press, carefully annealed, and finished according to the standard practice at the Bethlehem works.

The Rand Drill Company has removed its main office from 100 Broadway, New York, to the fifteenth floor of the new building just erected by the American Exchange National Bank, at 128 Broadway, corner of Cedar street. In its new office, the company will occupy the entire floor, in conjunction with its allied interests, the Pneumatic Engineering Company, the Rendrock Powder Company, and the Davis Calyx Drill Company.

A silver medal has been awarded August Mietz on the 6 H. P. Meitz & Weiss gas engine and 4 H. P. direct-connected kerosene engine exhibited by him at the Paris Exposition.

The Sullivan Machinery Company, of Chicago, have moved their offices from 54-60 North Clinton street to the Merchants' Loan and Trust Building, 135 Adams street. The store and shipping department will remain on Clinton street.

The trustees of the American School of Correspondence, 156 Tremont street, Boston, Mass., have decided to depart from custom in their policy of promotion. Believing that a personal exposition of the advantages of a school is often better than, or at least a great help to, printer's ink, they announce their willingness to grant a limited number of free scholarships to men in various large establishments in parts of the country. We are not advised as to the exact conditions, but anyone who thinks he would like to have one is invited to correspond with the school, giving his occupation, and the application will receive consideration by the trustees. The school calls attention to its course in Mechanical and Electrical Engineering (including a complete course in Mechanical Drawing), the former including Steam, Locomotive, and Marine Engineering. As its work is confined to these branches, they point out the probability of better work being done than would be likely where many other branches are taught.

In addition to the medals awarded on pneumatic tools, and mentioned in this department last month, mention should be made that the Q & C Company, of Chicago, was awarded a silver medal, and a bronze medal was awarded to the Standard Pneumatic Tool Company.

The John A. Roebling's Sons Company, of New York, received for its exhibit at the Paris Exposition two "Grand Prizes" and two gold medals. This company's display consists of two exhibits. One shows the product of their electrical department, and the principal feature of it is a full-size model of a section of underground trolley track, illustrating the communications with the conductive bars and the lead-encased cables which transmit the current to the cars. All kinds of telephone wires and cables are also shown and the means of connecting up and mounting. A second exhibit is in the department of metallurgy, and gives a comprehensive view of all the products of the Roebling works, with the exception of electrical conductors. A large model of the Brooklyn bridge, complete in all details, was the dominant feature of this exhibit. Samples of every variety of steel and copper wire were shown, from the largest sizes down to wire with a diameter of one-thousandth of an inch.

H. W. Johns Manufacturing Company, 100 William street, New York City, recently secured a contract from the Pittsburg Plate Glass Company, Ford City, Pa., for furnishing and applying their asbestos fire felt covering for their factory No. 3, in which plant they are now installing twelve new boilers and the necessary steam pipes. The contract in question will amount to over $2,000.

The new ship building plant for the Risdon Iron Works, at San Francisco, Cal., will be built by the American Bridge Company, of New York, and will consist of a boiler shop, machine shop, and foun-

dry—all of the latest design and most modern description.

The Aultman Company, Canton, O., have arranged with the C. T. Patterson Company, Ltd., New Orleans, to represent them in the sale of their complete line of elevating and conveying machinery and power transmitting machinery.

We are advised that the H. W. Johns Manufacturing Company, of New York, have secured a contract for supplying and applying their asbestos fire felt covering for the steam pipes, boilers and brine pipes at the Havana Brewery, Havana, Cuba. They are sending skilled labor from New York to carry out their contract, and it is the first instance of this kind that has come to our notice. There are a number of new power plants constructing in Havana, and the H. W. Johns Manufacturing Company believe in being on the field with their skilled labor and materials to insure their getting the work.

The American Bridge Company announce that Mr. August Ziesing has been appointed general western representative of the company, with headquarters at Chicago, Ill.

NEW CATALOGUES AND TRADE PUBLICATIONS

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Harrison Bros. & Co., Inc., Philadelphia. —"Why You Should Use Harrisons' Varnishes." A leaflet setting forth the advantages of using the varnishes manufactured by this house. Very interesting and instructive.

Keuffel & Esser Co., New York.—New catalogue of drawing materials, mathematical and surveying instruments. This catalogue of nearly 500 pages shows many additions to previous ones. An unusually large number of slide rules, new planimeters and pantographs is shown, while improvements are noted in the listing of steel tapes, current meters, hook gauges, tide gauges, aneroids, barographs, thermographs and hydrographs. Profile and cross-section rulings are shown on cloth.

General Electric Company, Schenectady, N. Y.—A 92-page pamphlet on the subject of "Aging of Transformer Iron," containing five important articles that have been issued regarding this subject, as follows: "The Aging of Transformer Iron," by Prof. W. Elwell Goldsborough; "On Slow Changes in the Magnetic Permeability of Iron," by Mr. W. M. Mordey; "Effects of Prolonged Heating on the Magnetic Properties of Iron," by Mr. S. R. Roget, B. A.; "Hysteresis in Sheet Iron and Steel," by Mr. Arthur Hillyer Ford; and "The Aging of Transformer Steel," by Mr. J. A. Capp. This pamphlet is interesting to every central station manager.

Crane Company, Chicago.—Handsome metal sign showing the Crane Company's 18-inch extra heavy iron body gate valve, with outside screw and yoke and by-pass. An attractive border is made up of wrought-iron pipe connected by fittings.

International Correspondence Schools, Scranton, Pa.—"What Are Your Wages?", a handsome folder, with attractive cuts by the three-color process of engraving. A list of the branches taught by these widely-known schools is included.

American Turret Lathe Company, Wilmington, Del.—"Three Points of View," being a very neat pamphlet illustrating and describing a 40-inch semi-automatic lathe.

Harrison Safety Boiler Works, Philadelphia, Pa.—Sixteenth edition of a catalogue of Cochrane Heaters for heating and purifying water for boiler feed and other purposes.

Browning Engineering Company, Cleveland, Ohio.—Bulletin No. 500, illustrating and describing in detail a new steam dock capstan.

Western Electrical Supply Company, St. Louis, Mo.—Catalogue No. 22 of motors, circuit breakers, and controlling devices.

Standard Welding Company, Cleveland, Ohio.—Catalogues in two colors, showing seamless steel tube bicycle parts.

American Steel & Wire Company, Chicago.—Catalogue No. 4 of extension, compression, torsion, and flat springs for buffers, bicycles, cars, carts and wagons, machinery, hinges, locks, valves, trolleys, and many other uses.

Rockwell & Rupel Company, Chicago.—Catalogue of the unit system of bookcases—the only system that has solved the question of providing the right amount of space for housing books, and adapting the cases quickly and conveniently to either increase or decrease.

W. F. & John Barnes Company, Rockford, Ill.—Price-list and descriptive catalogue of drilling machines and small lathes manufactured by this house. The line is a large one and well presented.

Risdon Iron and Locomotive Works, San Francisco.—Catalogue No. 10, Third Edition, of an extensive line of pumping machinery manufactured by this firm. Much information and many valuable tables are given.

Kinnear Manufacturing Co., Columbus, Ohio.—Catalogue H, illustrating many installations of steel rolling doors, shutters, and partitions.

Prentice Bros. Company, Worcester, Mass.—A very handy sized catalogue of drilling machines and engine lathes. All dimensions are given in both English and metric, and a comprehensive cable code is included.

International Time Recording Company, 277 Broadway, New York.—A striking brochure describing time-recording and time-stamping devices for workshops and factories.

H. W. Johns Manufacturing Company, 100 William street, New York.—Small catalogue, descriptive of the "Kearsarge" metallic packing, asbestos and rubber cloth wound packings, multiplex gaskets, etc.

Howells Mining Drill Company, Plymouth, Luzerne County, Pa.—Catalogue No. 2, illustrating and describing at length an extensive line of mining drills, compressed air or electric, for coal or rock. Many novel features are shown.

Betts Machine Co., Wilmington, Del.—Catalogue No. 10, containing an extensive line of planing machines for machine works, locomotive and railroad shops, ordnance factories, arsenals, and navy yards.

Baldwin Locomotive Works, Philadelphia, Pa.—A 450-page cloth bound, octavo catalogue of narrow gauge locomotives, adapted especially to gauges of 3 feet 6 inches or one metre. The catalogue is preceded by a highly interesting history of the locomotive engine, beginning with "Old Ironsides," constructed by Mr. Matthias W. Baldwin in 1832, and coming down to the very latest developments in steam and electric locomotives for every service.

Parsell & Weed, 129 West Thirty-first street, New York.—Neat little catalogue and price-list of the Franklin gas engine and parts.

F. L. Smidth & Co., 66 Maiden Lane, New York.—"What! Only Twenty-seven Revolutions?" a full description of "tube mills" and "ballmills" for grinding by means of flint balls.